Chiccine, Catherine

From: Madonia, Joseph <Joseph.Madonia@btlaw.com>
Sent: Monday, December 12, 2022 9:54 AM
To: Chiccine, Catherine
Cc: Madonia, Joseph; Susan Knowles
Subject: Ameren - On site work plan
Attachments: Huster - Work Plan for On-site ISCO with attachments.pdf

Cathy - here is the work plan we sent to Tonya and Clint. Thanks for helping us meet our schedule.

Sent from my iPhone

Pilot ISCO Work Plan for Huster Rd. Substation

Huster Road Substation

St. Charles, MO 63301

December 2022

Prepared for

Ameren Missouri

1901 Chouteau Avenue

St. Louis, MO 63103

Loureiro

Engineering • Construction • EH&S • Energy
Waste • Facility Services • Laboratory

Loureiro Engineering Associates, Inc.

112 Corporate Drive, Suite 2 • Portsmouth, NH 03801 • 603.778.1100 • www.Loureiro.com

An Employee-Owned Company

Pilot ISCO Work Plan for
Huster Rd. Substation

Huster Road Substation
St. Charles, MO 63301

December 9, 2022

Prepared for

Ameren Missouri
1901 Chouteau Avenue
St. Louis, MO 63103

Prepared by

LOUREIRO ENGINEERING ASSOCIATES, INC.
112 Corporate Drive, Suite #2
Portsmouth, NH 03801

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Table of Contents

1. INTRODUCTION

Loureiro Engineering Associates (LEA) has prepared this Pilot In Situ Chemical Oxidation (ISCO) Work Plan for remedial evaluation in the Huster Road Substation (work plan) on behalf of Ameren Missouri (Ameren). The work plan presents a summary of the proposed remedial approach to treat residual groundwater impacts within the Huster Road Substation on Huster Road in St. Charles, Missouri (Site) (**Figure 1**). The primary contaminants of concern (COCs) to be treated at the site are 1,2-cis-dichloroethene (cis-1,2-DCE) and vinyl chloride.

2. SITE CONCEPTUAL MODEL

The geology of the site consists of a silty clay/silt material 25 to 30 feet in thickness. The lower two to three feet transitions to a primarily silt composition. Underlying the cohesive unit is a medium grained sand material that extends from approximately 30 feet below ground surface (ft bgs) to the top of bedrock observed at approximately 110 ft bgs. The depth to groundwater at the site varies, dependent on the Mississippi River located approximately 2 miles north, but is typically encountered at approximately 20 feet bgs.

2.1 **Site Background**

Previous bench scale treatability studies performed by XDD Environmental (XDD) were used to determine the treatment effectiveness of several in situ chemical oxidation (ISCO) technologies. Refer to the *Plume Containment Pilot Study Work Plan (September 2014)* and the *Plume Containment Pilot Test Work Plan Addendum (December 2014)* for a detailed summary of the various technologies that were evaluated to treat site soils and groundwater.

Results of the treatability studies indicated alkaline activated sodium persulfate (AAP) was an effective technology to address the COCs in both site soils and groundwater. ISCO pilot tests were performed in 2014 (Phase 1) and 2015 (Phase II), targeting groundwater impacts north of the substation property in the vicinity of City Well W-5 and south of Highway 370. The impacted interval was approximately 15 feet and based on vertical impacts in groundwater, measured from approximately 32 ft bgs to 45 ft bgs. The pilot tests successfully reduced COCs in the treatment area without observing any adverse impact in City Well 5. The persulfate induces a chemical reaction upon contact with COCs and residence time in groundwater is limited. COC concentration levels in the off-site treatment area declined within a short time frame, a matter of weeks.

In order to supplement the success of multiple bioremediation applications at the site combined with the operation of a groundwater extraction treatment system (GETS), a larger-scale injection of AAP was chosen to aggressively target the existing COC mass on soils and groundwater within

the substation in the uppermost groundwater zone. Several factors were considered when developing the proposed remedial approach to prevent any negative impacts to the continued operation of the GETS and city wells that may become operational before, during, or after the ISCO application:

- groundwater dilution of AAP solution,
- total oxidant demand in subsurface soils and groundwater due to anaerobic conditions created by previous bioremediation applications,
- pH reduction over distance traveled (subsurface).

3. ISCO OBJECTIVES

The GETS was designed to contain and treat groundwater from the substation as it flows naturally to the north/northwest and influenced by City of St. Charles (City) production wells located upgradient. Ameren's primary objective of the ISCO application is to address the last remaining COC impacts within the substation. (**Figure 1**). The GETS was designed to contain and treat groundwater from the substation as it flows naturally to the north/northwest and influenced by City of St. Charles (City) production wells located upgradient. Ameren's primary objective of the ISCO application is to address the last remaining COC impacts within the substation. (**Figure 1**). The estimated remaining mass of contaminated material trapped in the subsurface soils and clays on the 8 -acre Site is approximately 4 lbs. (The estimated mass prior to remediation efforts was approximately 400 lbs.)

4. REMEDIAL DESIGN OVERVIEW

Fourteen temporary injection points will be installed prior to injection activities. Proposed injection locations are shown on **Figure 1** and are intended to focus treatment in areas with known residual COC impacts or areas directly in pathway of a potential extraction point used as a drinking water source. The ISCO application will consist of sodium persulfate (persulfate) and sodium hydroxide (NaOH) delivered to the site in 5,500-gallon stainless steel tankers. A mixture of persulfate, NaOH, and water will be injected simultaneously and mixed in-line to create an AAP solution concentration of approximately 95 grams per liter (g/L).

4.1 **Proposed ISCO Application**

The proposed AAP ISCO application is described in detail below.

- ISCO will be used to target soil and groundwater in the substation. The target interval is approximately 32 to 42 ft below ground surface (bgs) and may vary depending on the thickness of the overlying silty clay layer.

- Approximately 189,544 pounds (lb) of sodium persulfate will be applied during injection activities.
- Approximately 238,000 gallons, or the equivalent to one pore volume, will be injected during the ISCO application at a concentration of approximately 95 grams per liter (g/L) into an estimated 14 temporary injection locations. Each location is expected to receive approximately 17,000 gallons.
- Temporary injection points will be installed using a direct-push drill rig using 1-inch Sch 40 PVC with a 10-foot slotted screen.
- The anticipated radius of influence per injection location is approximately 15 ft. If evenly distributed, the injections will cover approximately 10,500 ft^2.
- Sodium persulfate will be received as a solid powder in 2,204-lb super sacks at an off-site facility and batched with potable water into a concentrated solution of approximately 317 g/L. The concentrated batch solution will be transferred into stainless steel tanker truck and delivered to the site. The concentrated solution will be diluted during injection with NaOH and water to achieve the target injection concentration of 95 g/L.
- Using the 2:1 molar ratio of sodium hydroxide to sodium persulfate for alkaline activation, approximately 63,686 lbs of sodium hydroxide will be injected with the persulfate. The sodium hydroxide will be purchased as a 25% solution (approximately 23,897 gallons required). The use of sodium hydroxide will elevate the pH in the contact zone to level greater than 10.
- A manifold skid will be used to inject the solution into 7-10 locations simultaneously with an anticipated flow rate of 5-10 gpm in each location.
- Assuming the anticipated flow rates can be sustained throughout the application, the ISCO injections are estimated to be completed in 10 days (not including mobilization or demobilization).

Currently, very low levels of COCs exist on the west side of the substation. However, to facilitate effectiveness of the application of the treatment, operation of City Wells 4 and 5 should be coordinated to create groundwater "stagnant zones" within the substation to maximize persulfate residence time. Alternatively, if coordination of City Well 5 and 4 pumping rates is not feasible, operation of City Well 4 should be deferred for 30 days post ISCO application to maximize persulfate residence time.

Following the installation of the temporary injection points, each temporary location will be developed/purged until groundwater quality parameters of temp, pH, conductivity, ORP, and turbidity stabilize. Following stabilization, samples will be collected and analyzed by USEPA Method 8260. The data collected will be used to define areas of primary need for the greatest mass reduction and volumes injected into these locations may be adjusted so as ensure contact of the oxidant with the impact present. Upon completion of the injection, the temporary injection wells will be removed in accordance with state regulations.

4.2 **ISCO Application – Process Monitoring**

Periodic monitoring for persulfate or elevated pH, which indicate distribution of the oxidant will be conducted at existing monitoring wells within the substation during the ISCO application. Chemetrics test kits will be used to test the persulfate concentration and pH paper will be used for a general reading on alkalinity. Adjacent wells will be monitored for pH to confirm continuing persulfate reaction with COCs. This information will be used to adjust location volume and flow rate to better ensure contact of solution with the impact that is present.

4.3 **Post-ISCO Application – Performance Monitoring**

Groundwater monitoring post-application is required to evaluate the overall treatment effectiveness and determine if rebound is occurring. The post-application monitoring plan will be conducted monthly for a minimum of 5 months, starting 1 month after the ISCO application is complete. The monitoring duration may change based on the results of the ISCO application monitoring.

4.4 **Coordination with EPA Site Investigation**

The United States Environmental Protection Agency (USEPA) plans on conducting direct push site investigation activities north of both the substation property and Highway 370. The ISCO application cannot impact or interfere with such activities because the on-site persulfate injection will induce a chemical reaction that will occur only within substation boundaries and that will result in limited residual residence time. The previously installed ZVI barriers remain in place and are operational as will be the GETS. Monitoring will ensure that any discharges from the Site comply with National Pollutant Discharge Elimination System (NPDES) pH permit conditions.

4.5 **Re-Establishment of Bioremediation**

From 2014 through 2022, several in situ bioaugmentation/bioremediation applications have been performed in the substation. Each application was designed to target within the vertical interval to be treated in the proposed ISCO application (45 feet to 55 feet below ground surface [bgs]). During each bioaugmentation/bioremediation application, groundwater was

amended to create ideal subsurface conditions for chlorinated solvent-degrading bacteria, dehalococcoides (DHC), to degrade site COCs into innocuous end products, ethene and ethane.

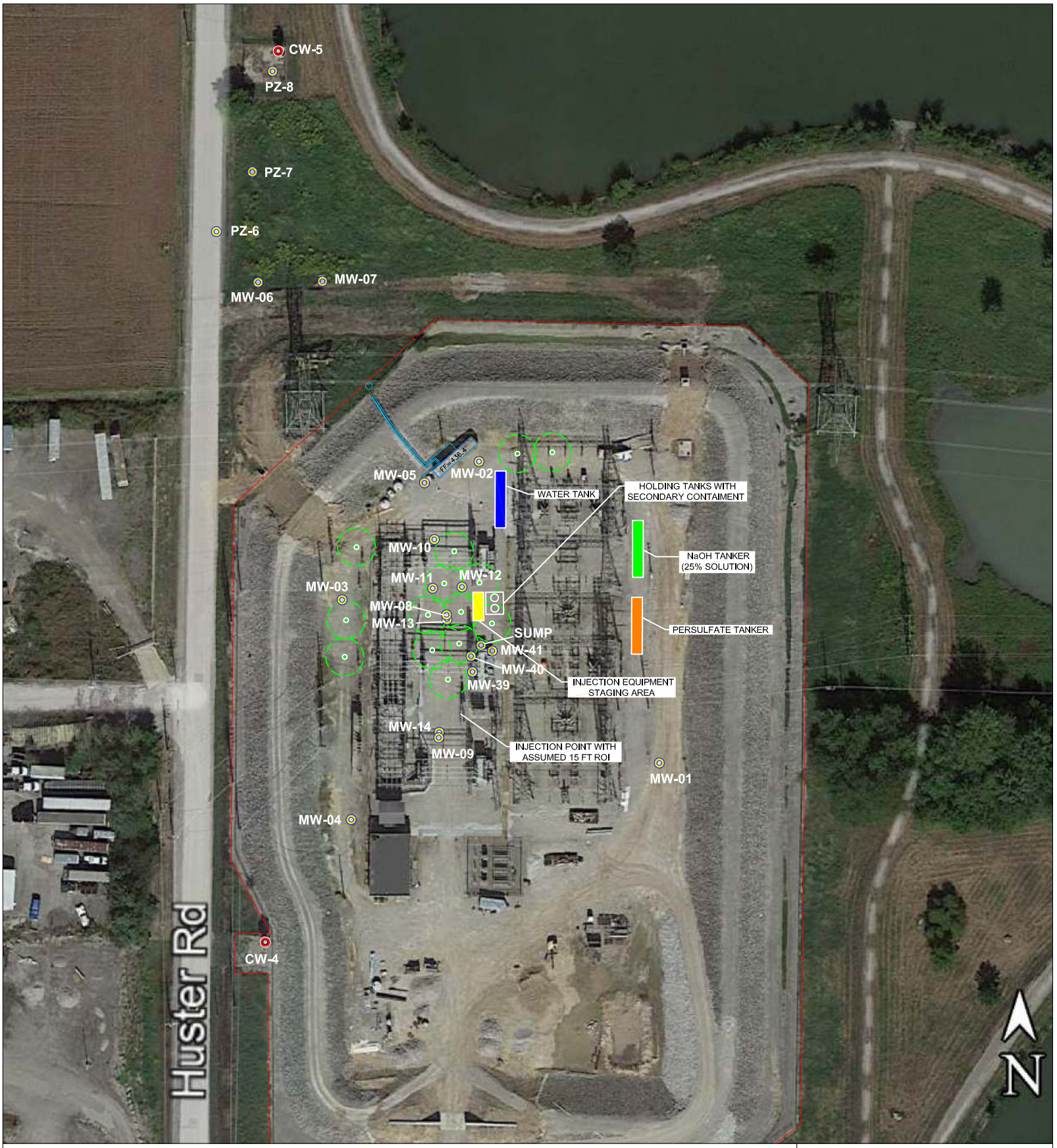
The proposed ISCO application will eliminate the DHC population that has been built up over the past 8 years. After post-injection performance monitoring is complete, and the effectiveness of the ISCO applications has been determined, additional bioaugmentation/bioremediation injections will be performed at the site to re-establish the DHC population and bioaugmentation treatment zone in the subsurface. The scale and scope of those injections will be provided at a later date, in a separate document.

5. PILOT TEST SCHEDULE

The schedule and estimated task duration is presented below. LEA can be prepared to start the mobilization portion of the ISCO pilot test the week of January 23, 2023.

Task	**Date (duration)**
AAP ISCO Pilot Test Application	
Preparations and Procurement	December 2022
Temporary Injection Well Installation and Baseline Sampling	January 2023
On-Site Mobilization (3 days)	January 23 - 25, 2023
Chemical Delivery	January 24 - 25, 2023
ISCO Application	January 26 through February 17, 2023
Site Demobilization	February 20 and February 21, 2022
Post-ISCO Application Performance Monitoring	March/April 2023 through July 2023 (Minimum 5 months)
Re-establish Bioremediation	June/July 2023

FIGURE



LEGEND

PROPOSED TEMPORARY INJECTION LOCATION (ASSUMED 15 FT ROI)

PZ-11 MONITORING WELL

CW-6 CITY WELL

NOTES:

1. Radius of influence (ROI) per injection location is assumed at 15 feet based on proposed injection volumes and assumed soil porosity.

0 100

SCALE (FEET)

Loureiro

SCALE: AS SHOWN	TITLE: SITE PLAN ISCO TREATMENT AREA - SUBSTATION HUSTER RD. ST. CHARLES, MO
DATE: DECEMBER 2022	
PROJECT NO.: 088UE2.08	
CLIENT: AMEREN	
DRAWN BY: PC	DRAWING NO. FIGURE 1
CHECKED BY: DI	REV.
APPROVED BY: DI	

APPENDICES

Project Name:	Huster Road Substation	Commission or Project #:	088UE2.01
Client Name:	Ameren Missouri	Project Location:	St. Charles, Missouri
Field Work Start Date:	1/1/2022	Anticipated Duration:	3 years
Project Description (include anticipated work tasks):	Operation and maintenance of the groundwater extraction system (GETS), in situ bioremediation / bioaugmentation injections (as needed), associated groundwater monitoring, and soil sampling / air monitoring during site construction activities (not associated with remedial activities) and waste characterization.		

This Project Health and Safety Plan (HASP) was prepared for Loureiro employees performing a specific scope of work. It was prepared based on the best available information regarding the physical and chemical hazards known or suspected to be present on the project site. While it is not possible to discover, evaluate, and protect in advance against all possible hazards, which may be encountered during the completion of this project, adherence to the requirements of the HASP will significantly reduce the potential for occupational injury or illness. This HASP must be completed by a competent person, approved by the Project Manager or Superintendent, and reviewed and signed by the project team.

Job Hazard Analyses (JHAs) for the primary work tasks identified for this project shall be attached to this HASP. The sections below identify the hazards of the project and minimum safe work practices to be used by the project team while on-site.

This HASP was completed by:	**Karen O'Shaughnessy**	**Date:**	**1/13/2022**
Project Manager or Superintendent:	**Derek Ingram**	**Date:**	**1/13/2022**

Project Team & Emergency Contacts

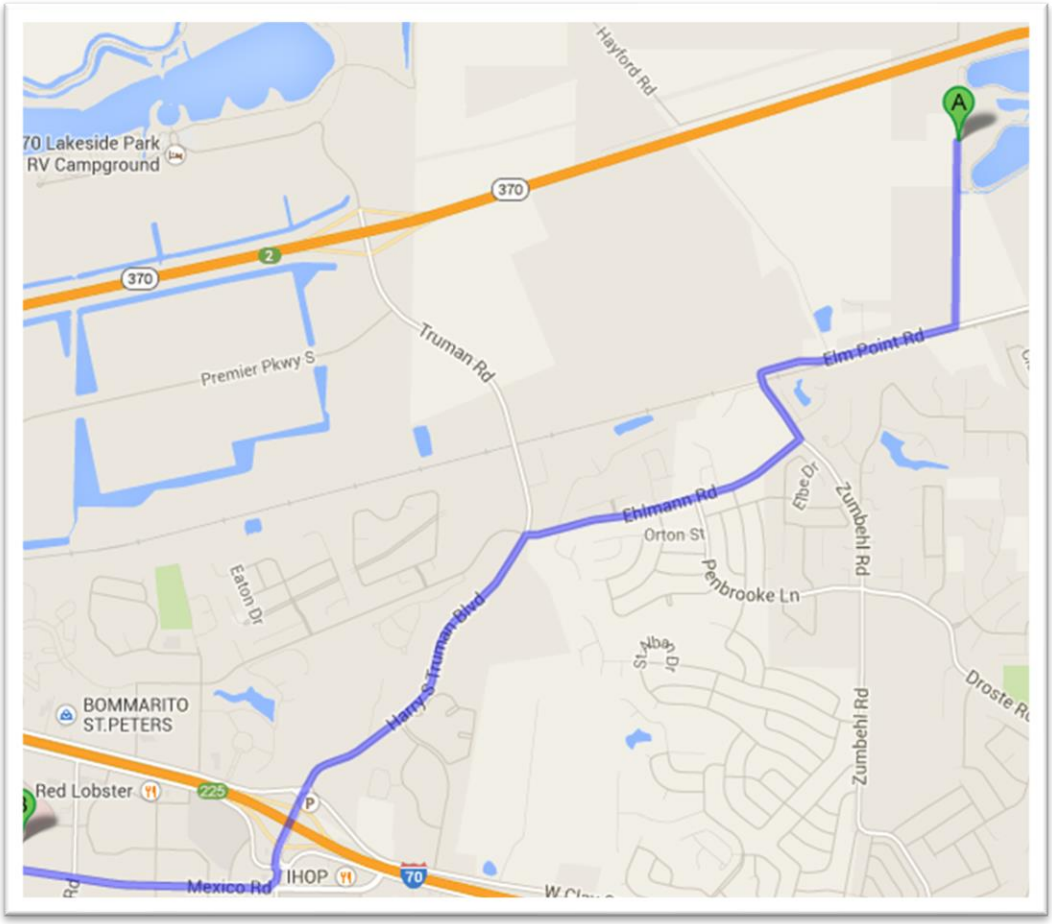
Company / Entity	Role	Name	Primary Contact Number
Loureiro	Project Manager / Superintendent	Derek Ingram	314-609-3065
	Safety Lead	Reginald Gardner	618-567-4703
	Field Personnel	Troy Eppinger	618-407-2347
Ameren	Project Manager	Barbara Miller	314-223-4655
	Director Substation Maintenance & Construction	Joe Fitzgerald	314-288-9539
	Substation Supervisor	Jay Pidcock	314-608-6146
	Substation Emergency Response	Ameren Distribution Dispatch	573-681-7567
		Ameren Transmission Dispatch	314-554-2262
Local Fire Department	Emergency Response	St. Charles Fire Department	911
Local Police		St. Charles Police Department	911
Sedgwick	Injury Management	Clinical Consultation	1-855-811-5702
Poison Control	Poison Emergency	U.S Poison Control Centers	800-222-1222
DigSafe	Utility Clearance	National DigSafe Call Center	811
Missouri Department of Natural Resources (MDNR)	Project Manager	Feyi Ilesanmi	
MDNR Environmental Emergency Response	Discharge, Spill, and/or Release Notification	NA	573-634-2436

Stop Work Authority - Any employee or subcontractor may halt a job or task when a hazardous situation appears imminent. Work may resume once the hazard is eliminated or controlled.

Emergency Medical Facility Information

Medical Center Name: **Barnes-Jewish St. Peters Hospital Location**

Address: **10 Hospital Drive; St. Peters, MO 63376**



Additional Emergency Information

In addition to any client or work location requirements, follow this basic emergency protocol in the event of an emergency:

1. In the event of a fire or other emergency, evacuate as soon as possible to a safe assembly location upwind of the incident.
2. If fire extinguishers are available, they may only be used by trained personnel against a fire still in its beginning stage.
3. In the event of an injury or illness:
   a. For life-threatening incidents, initiate emergency response (911 or local contact number) and notify Manager.
   b. If the injury is not life threatening, but may require clinical attention or advice, the employee notifies his or her Manager then contact Health & Safety.
   c. A first-aid kit should be available for minor injuries, by an employee who is first aid trained.
4. If chemicals are handled on-site, ensure proper spill prevention and containment is immediately available for use, spill response can only be handled by trained personnel, otherwise evacuate and contact the local fire department or designated responder.
5. All workplace injuries and illnesses must be reported to Loureiro H&S as soon as possible. For workplace injury or illness incidents, the Manager must complete an Incident Investigation Form (available in Appendix A of the Incident Reporting Program) within 24 hours of the incident and submit it electronically to Loureiro H&S department.

Evacuation Assembly Area: Site layout showing assembly area is attached	
Emergency Communication:	☒ Cell Phone ☒ Hand Signals ☐ Air Horn ☐ Radio ☒ Verbal ☐ Other:

☒ Client specific safety procedures or protocols included on page 7 or attached to this HASP.

Project Hazard Assessment (Check all that apply)

General Hazards ☐ N/A	☒ Aerial Lift Work (Operator training required)	☐ Falls from Elevated Work (>4 feet)	☐ Rotating Equipment
	☒ Compressed Gases Storage/Use	☐ Flammable Liquids Storage/Use	☒ Slips and Trips
	☐ Confined Spaces (CSE Training Required for Permit Entry)	☒ Forklifts/Lulls (Operator training required)	☒ Utilities – Overhead or Underground
	☒ Construction Exposure	☐ Heavy Equipment Use	☒ Vehicular Traffic
	☒ Drilling/Test Pitting	☐ Hot Work – Cutting, welding, or grinding generated sparks or heat sources. (Hot work permit required)	☐ Working In, Over, or Adjacent to Water
	☒ Energized Equipment or Circuits	☐ Manufacturing Area Exposure	☐ Falling/Overhead Objects
	☐ Excavation/trenching Work	☐ Pinch Points	☒ Power Equipment/Tool
Biological / Environmental Hazards ☐ N/A	☒ Excessive Cold (<32°F)	☒ Poisonous Plants (Ivy, oak, sumac, ragweed, hogweed, etc.)	☐ Wild/Dangerous Animals
	☒ Excessive Heat (>91°F)	☒ Ticks	☒ Wet Conditions
	☐ Microbiological (bacterial/viral) such as in wastewater or research labs	☒ Venomous animals (Spiders, wasps, bees, snakes, etc.)	☐ Other:
	☒ Mosquitoes		
Chemical Hazards ☐ N/A	☐ Acid and Alkaline Substances	☒ Oxidizers	☒ *List site-specific constituents (or attach to HASP):*
	☒ Contaminated Soil/Particulate	☐ Radiological (**Contact H&S**)	1. Chlorinated VOCs (PCE, TCE 1,1-DCE, trans-1,2-DCE, cis-1,2-DCE, and VC)
	☐ Flammable/Explosive	☐ Reactive	2. Sodium permanganate (residual oxidant in groundwater from previous remedial activities)
	☐ Organic Solvents	☒ Volatiles/Semi Volatiles	
Ergonomic Hazards ☐ N/A	☒ Bending/Twisting	☒ Pulling/Tugging	☐ Repetitive Motion
	☐ Climbing	☒ Lifting	
Eye/Face Hazards ☐ N/A	☐ Acid and Alkaline Substances	☐ Particulates	☐ Welding Arc
	☐ Laser Operations	☐ Sharps/Punctures	☐ Other:
	☒ Liquid Splashes	☐ Ultraviolet Radiation	
Foot Hazards ☐ N/A	☒ Crush	☐ Conductive Hazards	☐ Other:
	☒ Sharps/Puncture	☐ Chemical Hazards	
Hand Hazards ☐ N/A	☐ Acid and Alkaline Substances	☒ Handling Contaminated Media	☐ Sharps/Punctures
	☒ Excessive Cold (Surface <40°F)	☐ High Vibration	☐ Other:
	☒ Excessive Heat (Surface >100°F)	☐ Organic Solvents	
Hearing Hazards ☐ N/A	☐ Impact Noise	☒ High Ambient Noise	☐ Other:
Respiratory Hazards ☐ N/A	☐ Acid Gases	☐ Lead (**Contact H&S**)	☐ Oxygen Deficient
	☐ Asbestos (**Contact H&S**)	☐ Mercury Vapor	☐ Particulate (respirable)
	☐ Asbestos/Particles	☐ Methylamine	☐ Silica (respirable, crystalline)
	☐ Ammonia	☐ Mold	☐ Welding Fumes
	☐ Chromium	☒ Organic Vapors	☐ Other:

Personal Protective Equipment Requirements (Check all that apply)

Completion of this section also serves as a certified personal protective equipment (PPE) hazard assessment.

Level D Work Gear ☐ N/A	☐ Cotton Coveralls ☒ Hard Hat ☒ Hi-Visibility Vest or Equivalent	☒ Long Pants ☐ Rubber Boots ☒ Sleeved shirts (short or long, as appropriate)	☒ Safety Glasses ☒ Safety-Toed Boots
Body Protection ☐ N/A	☐ Fire Resistant Clothing ☐ Fully Encapsulating Suit ☐ Tyvek Coveralls or Equivalent	☐ Lab Coat ☒ Tyvek® QC Coveralls or Equivalent ☐ Tyvek® SL Coveralls or Equivalent	☐ Insulated Coveralls ☐ Personal Fall Arrest System (appropriate harness, lanyard, anchor point) ☐ Other:
Electrical Clothing / Equipment ☐ N/A	☐ Arc-Flash Hazard Clothing: (qualified electrical workers only) ☐ PPE Category 1 ☐ PPE Category 2 ☐ PPE Category 3 or 4 (Not allowed by Loureiro, must be subcontracted)	☐ High Visibility Vest (arc rated) ☐ Personal Fall Arrest System (arc rated) ☐ Insulated Tools ☐ Multi-meter	☒ GFCI ☐ Other:
Eye / Face Protection ☐ N/A	☒ Chemical Goggles ☒ Face Shield	☐ Welding Goggles ☐ Welding Helmet	☐ Welding Screens
Hand Protection ☐ N/A	☐ Anti-Vibration Gloves ☐ Butyl Gloves ☐ Cotton Gloves ☐ Insulated Gloves or Glove Liners	☒ Cut-Resistant Gloves ☐ Leather Gloves ☐ Neoprene Gloves	☐ Rubber Gloves ☒ Nitrile Gloves ☐ Other:
Head Protection ☒ N/A	☐ Bump/Miners Helmet	☐ Head Lamp	☐ Other:
Hearing Protection ☐ N/A	☒ Ear Plugs* *For noise levels exceeding 85dBA. Check the Noise Reduction Rating of plugs to ensure adequate protection.	☒ Ear Muffs*	☐ Ear plugs and muffs** **Dual protection is recommended by NIOSH for noise levels exceeding 100 dBA.

Respiratory Protection
☒ N/A

Respiratory Protection (If respiratory protection is required, refer to the Respiratory Protection Program of the Corporate H&S Program Manual. *Every employee shall ensure that facial hair does not interfere with the effectiveness of their respirator.* **Each employee voluntarily wearing a respirator must have prior approval from H&S department)**

Respirator Type	Cartridge Types	
☐ Dust Mask (nuisance dust)	☐ Particulate P100	☐ Other:
☐ Half Face	☐ Organic Vapor	
☐ Full Face	☐ Mercury Vapor	
☐ Powered APR	☐ Acid Gas	
☐ Airline Respirator or SCBA (Contact H&S)	☐ Ammonia / Methylamine	

Additional PPE ☐ N/A	☐ Insect gaiters ☒ Insect Repellant (DEET, permethrin)	☐ Personal Flotation Device ☒ Sunscreen (broad spectrum)	☐ Waders ☐ Other:

Air Monitoring Protocol (Check all that Apply, if Required)

Task(s) Requiring Monitoring ☐ N/A	☐ Confined Space Entry ☒ Excavation	☐ Exclusion Zone Monitoring ☐ Worksite Perimeter Monitoring	☐ Other:
Air Hazards ☐ N/A	☐ Asbestos (**Contact H&S**) ☐ Carbon Monoxide ☐ Dioxins ☐ Hexavalent Chromium ☐ Respirable Crystalline Silica (air monitoring not required if Table 1 is followed. See page 6 for more silica controls)	☐ Hydrogen Sulfide (H2S) ☐ Lead **(Contact H&S)** ☐ Particulate ☐ PCBs	☒ Volatile Organics ☐ Oxygen ☐ Other: ☐ Hydrocarbons
Air Monitoring Equipment / Device ☐ N/A	☐ Aerosol/Dust Meter ☐ Colorimetric Tubes ☐ Heat monitoring equipment ☐ Multi-gas meter	☐ Noise Meter ☐ Personal Sampling Badges ☐ Personal Sampling Pumps ☒ Photoionization Detector	☐ Other:

Equipment	Chemical of Concern	Action Levels	Safety Action
☐ Aerosol Dust Meter	Nuisance Dust or Particulates	Any visual observation of uncontrolled dust or >5 mg/m^3 in work zone; or >0.150 mg/m^3 above background at work zone perimeter.	Stop work, apply wet controls to reduce dust generation, other controls such as HEPA vacuum units for power tools may also be evaluated as applicable.
☐ Multi-Gas Meter	Hazardous Atmosphere	Oxygen >19.5%-<23.5% LEL < 10% H2S < 10 ppm CO < 35 ppm	Stop work, apply ventilation controls to bring the atmosphere within safe limits. Monitor continuously if atmosphere does not improve, stop work, and **contact H&S**.
☒ PID	Volatile Organics	> 5 ppm sustained for >1 minute or any reading > 10 ppm in breathing zone.	Stop work; apply ventilation to reduce concentrations. If concentrations cannot be reduced, stop work, move to safe locations, and **contact H&S**.
☐ Other			

Additional Planning Considerations and Controls

Work Area / Traffic Controls	☒ Caution/Warning Tape	☐ Police Detail/Escort	☒ Work Zone Signage
	☒ Fencing	☒ Traffic Cones	☐ Other:
	☐ Low Visibility/Evening Work	☐ Traffic Control Plan Required (refer to plan)	
	☐ Flaggers	☐ Vehicle Barriers	
Heat Stress Controls	☒ Water and rest breaks provided	☒ Potable water onsite	☐ Other:
	☒ Employees trained in recognition of heat-related illnesses	☒ Access to AC in vehicle, office, trailer, nearby building, etc.	
Sanitation	☒ Portable toilet (1 per 20 workers – Doesn't apply to mobile crews with transportation readily available to nearby toilet facilities	☐ Showers/Changing Rooms – Needed when project is greater than 6 months or if decontamination procedures indicate a need	

Hazard Communication

Which hazardous chemicals will be used or maintained at the jobsite by Loureiro personnel?

☐ None. No further action needed.	☒ **A**ttach inventory list and Safety Data Sheets (SDSs). Refer to the SharePoint Site for database of current SDSs, or contact the chemical manufacturer directly for SDS. *All SDSs for this project must be saved to the project folder, in the Health & Safety folder.*

Crystalline Silica Exposure Control Plan

Any tasks involving sanding, drilling, jackhammering, sawing, or mixing of asphalt, brick, concrete products, rock, sand, or stone?

☒ None. No further action needed.	☐ Employees Avoid All Respirable Silica-Generating Areas	☐ Exposure Determination Needed (required if employees have exposure and OSHA Silica Table 1 is not followed – **contact H&S**)
	☐ Follow All Controls in OSHA Silica Table 1 (located in the Construction Safety Program in the Corporate H&S Program Manual)	☐ Routine Observations by Competent Person (required for construction projects generating silica above 25 µg/m3). The Competent Person for this project is:

Permit Required Activities

Any Loureiro required permits and Client required permits should be included with this HASP.

	Activity	**Permit Process**
☒ None. No further action needed.	☐ **Confined Space Entry**. Will the work include a permit required entry of a confined space by employees following this HASP?	CSE Planning Checklist and Entry permit(s) must be attached to this HASP and completed as applicable. They are available in the Confined Space Entry Program of the Corporate H&S Program Manual.
	☐ **Lock Out / Tag Out**. Will hazardous energies need to be controlled to conduct work tasks?	Equipment-specific energy control procedures will be developed and attached to this HASP.
	☐ **Hot Work**. Will hot work be performed by employees following this HASP?	Hot work permit(s) must be attached to this HASP and completed as applicable. Permit is available in the Construction Safety Program of the Corporate H&S Program Manual.
	☐ **Groundbreaking**. Will groundbreaking be performed by employees following this HASP?	Pre-Groundbreaking Checklist and Groundbreaking Permit(s) must be attached to this HASP and completed as applicable. Checklist and Permit are available in the Utility Location Program of the Corporate H&S Program Manual.
	☐ **Client required permit**:	

Specialized Requirements

(Please check if any of the following is required for work on the Site. Contact H&S for further guidance)

☐ None. No further action needed.	☐ Confined Space Entry	☐ OSHA 10 Hour General Industry Safety Training
	☐ First Aid/CPR *(Required if emergency care is more than 3-4 minutes from project location)*	☐ OSHA 30 Hour Construction Safety Training
	☒ HAZWOPER 40 Hour Training & Annual Refresher	☐ Powered Industrial Vehicle Operation (PIV)
	☒ HAZWOPER 8 Hour Supervisory Training (Required for Site Safety Officer/Field Lead/Project Manager)	☐ Silica Awareness Training
	☐ Lock Out / Tag Out	☒ Other: **Ameren Contractor EH&S Training must be completed before entering the substation**
	☒ OSHA 10 Hour Construction Safety Training	

Surveillance Components

Refer to the Medical Surveillance Program of the Corporate H&S Program Manual for guidance on this section.

☐ None. No further action needed.	☒ HAZWOPER Medical Surveillance	☐ USDOT Screenings
	☐ Medical Clearance for Respirator Use	☐ Vision Test (required every 3 years to operate a PIV)
	☐ Silica Medical Clearance (for employees wearing respirator for silica protection ≥ 30 days per year.)	☒ Client Required Screenings
	☐ Other:	

Decontamination Procedures

☐ Not Required ☒ Required (Attach procedures to HASP)

Job Hazard Analysis

Please list all JHA's for the project and attach them to this HASP

1. General Site Activities
2. In Situ Bioremediation / Bioaugmentation Injection
3. Groundwater Monitoring
4. Soil Monitoring and Sampling
5. Groundwater Extraction System (GETS) operation and maintenance
6.

Client Specific Emergency Procedures

Please summarize any additional emergency procedures or reporting protocols below or attach to this HASP

Immediately contact:

Ameren Distribution Dispatch at (573) 681-7567 and Ameren Transmission Dispatch at (314) 554-2262.

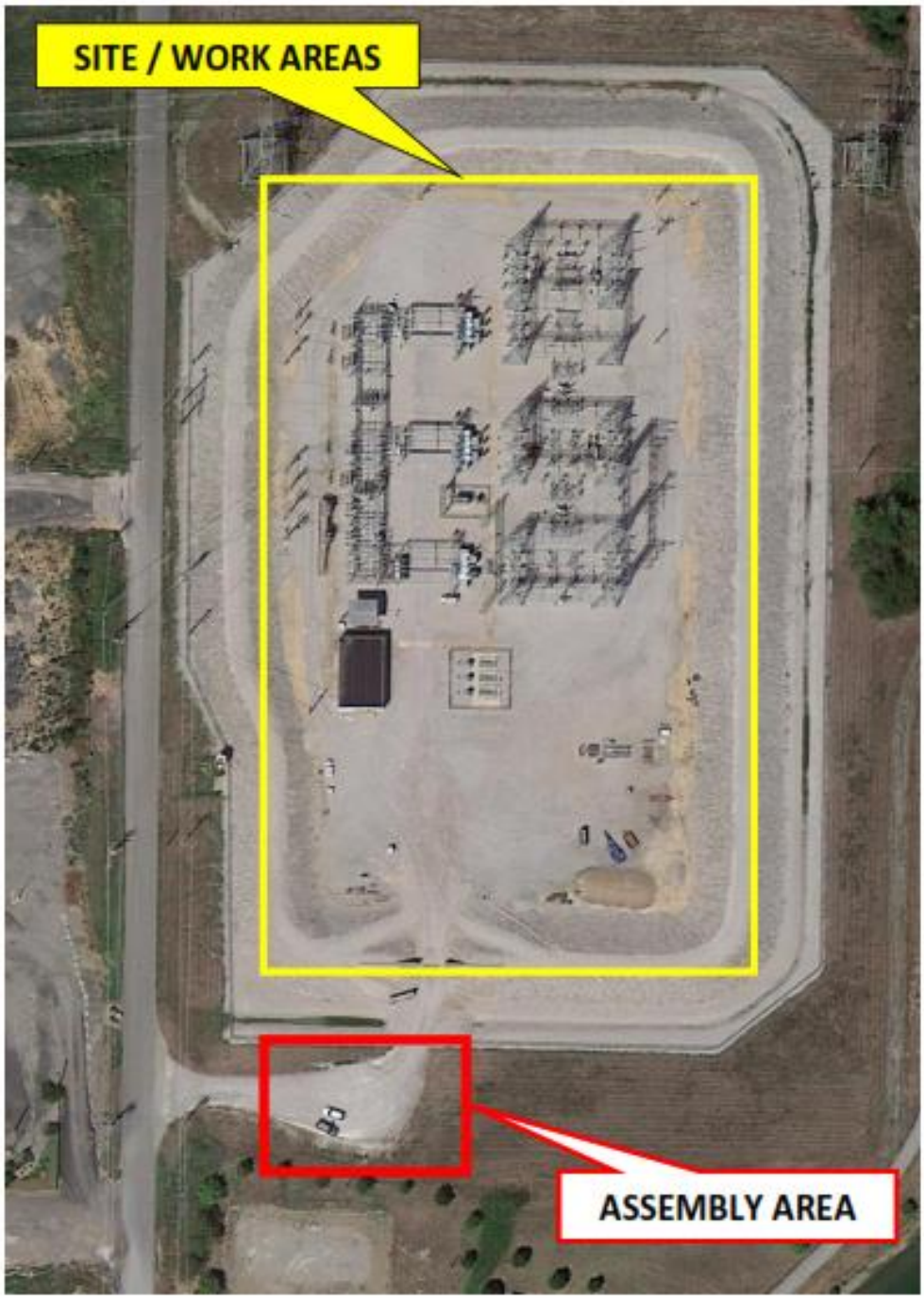
Project Name:	Huster Road Substation	Commission or Project #:	088UE2.01
Client Name:	Ameren Missouri	Project Location:	St. Charles, Missouri
Field Work Start Date:	1/1/2022	Anticipated Duration:	3 years
Project Description (include anticipated work tasks):	Operation and maintenance of the groundwater extraction system (GETS), in situ bioremediation / bioaugmentation injections (as needed), associated groundwater monitoring, and soil sampling / air monitoring during site construction activities (not associated with remedial activities) and waste characterization.		

HASP Acknowledgement

(I acknowledge that I have reviewed this HASP, and all attachments, and understand its requirements)

Employee Name / Signature	Company / Entity	Date Acknowledged

ASSEMBLY AREA



Decontamination Procedures

The JHAs included in the HASP outline procedures to minimize contamination of on-site personnel. **In most cases, PPE will be removed without need for decontamination procedures and will be deposited in a designated container for disposal.**

There is a potential that certain tasks will require implementation of the personal decontamination procedures outlined below. Such a determination will be made by the site safety lead and will typically be presented during the daily safety meeting. Prior to commencing work, all personnel will be trained in routine decontamination procedures by the site safety lead or appointed designee.

Procedure:

All employees leaving a contaminated area shall be decontaminated as appropriate. Personal decontamination procedures, if deemed necessary by the site safety lead, will be as follows:

- Rinse and dispose of outer disposable protective clothing and boots.
- If permeable clothing becomes wetted with hazardous materials, the clothing should be removed. Such wetted clothing shall be decontaminated or disposed of before it is removed from the work zone.
- Remove outer non-disposable protective clothing while keeping inner gloves/boots on.
- Wash face, hands, and forearms.

Location:

Decontamination should occur in a location that will minimize the exposure of uncontaminated employees or equipment to contaminated employees or equipment. A personal decontamination station where workers can drop equipment and remove PPE will be set up inside the boundary of the work zone.

Good personal hygiene practices will be followed at all times. Handwashing facilities will be provided, and personnel are required to wash hands prior to entering vehicles, eating, drinking, or when departing the work zone.

EOS Remediation, LLC

EOS PRO

SAFETY DATA SHEET

Section 1: Identification	
Product Name:	**EOS Pro**
Chemical Description:	Mixture; vegetable oil emulsion
Manufacturer:	EOS Remediation 1101 Nowell Road Raleigh, NC 27607 (P): 919-873-2204 www.eosremediation.com
Recommended Use:	Groundwater bioremediation (environmental applications)
Restricted Use:	Not for human consumption.
24-Hour Emergency Contact:	ChemTel: United States (P): 800-255-3924 ChemTel: International (P): 813-248-0585

Section 2: Hazard(s) Identification	
Hazard Classification:	Irritant (skin and eye)
Signal Word:	Warning
Hazard Statement(s):	Potential eye and skin irritant.
Pictograms:	
Precautionary Statement(s):	Not for human consumption. Do not store near excessive heat or oxidizers. Avoid contact with eyes and skin. Wear protective gloves and eye protection.

Section 3: Composition/Information on Ingredients		
Common Name(s)	**CAS NO.**	**% by Weight**
Soybean Oil	8001-22-7	59.8
Food Grade Emulsifiers Trade Secret[1,2]	Proprietary	10
Soluble Substrates Trade Secret[1,2]	Proprietary	4
Food Additives/Preservatives Trade Secret[1]	Proprietary	0.3
Nutrients/Extracts Trade Secret[1,2]	Proprietary	1
Water	7732-18-5	Balance

1 – The precise composition of this product is proprietary information. A more complete disclosure will be provided to a physician in the event of a medical emergency.

2 – The soluble substrates and emulsifiers are generally recognized as safe for food contact.

Section 4: First-Aid Measures	
Routes of Exposure	**Emergency First-Aid Procedures**
Inhalation	Remove to fresh air.
Eye Contact	Flush with water for 15 minutes; if irritation persists see a physician.
Skin Contact	Wash with mild soap and water.
Ingestion	Product is non-toxic. If nausea occurs, induce vomiting and seek medical attention.

Section 5: Fire-Fighting Measures	
Extinguishing Media:	CO_2, foam, dry chemical Note: Water, fog and foam may cause frothing and spattering.
Special Fire Fighting Procedures:	Wear self-contained breathing apparatus and chemical resistant clothing. Use water spray to cool fire exposed containers.
Fire Hazard(s):	Burning will cause oxides of carbon.

Section 6: Accidental Release Measures	
Personal Precautions:	Avoid contact with eyes and skin. Do not consume.
Emergency Procedures:	N/A
Methods & Materials used for Containment:	Compatible granular absorbent
Cleanup Procedures:	Spread compatible granular absorbent over spill area and sweep using broom and pan; dispose in appropriate receptacle. Clean area with water.

Section 7: Handling and Storage	
Safe Handling & Storage:	Do not store near excessive heat or oxidizers.
Other Precautions:	Consumption of food and beverages should be prevented in work area where product is being used. After handling product, always wash hands and face thoroughly with soap and water before eating, drinking, or smoking.

Section 8: Exposure Controls/Personal Protection		
Exposure Limits		
OSHA PEL:	NE	
ACGIH TLV:	NE	
NIOSH REL:	NE	
Personal Protective Measures		
Respiratory Protection:	Not normally required. P95 respirator if aerosols might be generated.	
Hand Protection:	Protective gloves are recommended	
Eye Protection:	Recommended	
Engineering Measures:	Local exhaust ventilation if aerosols are generated	
Hygiene Measures:	Wash promptly with soap & water if skin becomes irritated from contact.	
Other Protection:	Wear appropriate clothing to prevent skin contact.	

Section 9: Physical and Chemical Properties			
Appearance:	White Liquid	Explosive Limits:	NE
Odor:	Vegetable Oil	Vapor Pressure:	NE
Odor Threshold:	NE	Vapor Density:	Heavier than air
pH:	Neutral	Relative Density:	0.96-0.98
Melting Point/Freezing Point:	Liquid at room temperature	Solubility:	Dispersible
Boiling Point:	212°F (100°C)	Partition coefficient:	NE
Flash Point:	>300°F (149°C)	Auto-ignition Temperature:	NE
Evaporation Rate:	NE	Decomposition Temperature:	N/A
Flammability (solid, gas):	NE	Viscosity:	500-1500 cP

NE – Not Established

Section 10: Stability and Reactivity	
Stability:	Stable
Incompatibility:	Strong acids and oxidizers
Hazardous Decomposition Products:	Thermal decomposition may produce oxides of carbon
Hazardous Reactions/Polymerization:	Will not occur
Conditions to Avoid:	None known

Section 11: Toxicological Information		
Likely Routes of Exposure:		Ingestion, dermal and eye contact
Signs and Symptoms of Exposure:		None known
Health Hazards		
	Acute:	Potential eye and skin irritant
	Chronic:	None known
Carcinogenicity		
	NTP:	No
	IARC:	No
	OSHA:	No

Section 12: Ecological Information (non-mandatory)
There is no data on the ecotoxicity of this product.

Section 13: Disposal Considerations (non-mandatory)	
Waste Disposal Methods:	Dispose of according to Federal and local regulations for non-hazardous waste. Recycle, if practical.

Section 14: Transport Information (non-mandatory)
The product is not covered by international regulation on the transport of dangerous goods.
No transport warning required.

Section 15: Regulatory Information (non-mandatory)
N/A

Section 16: Other Information	
Date of Preparation:	29 May 2014
Last Modified Date:	5 September 2014
The information contained herein is based on available data and is believed to be correct. However, EOS Remediation, LLC makes no warranty, expressed or implied, regarding the accuracy of this data or the results to be obtained thereof. This information and product are furnished on the condition that the person receiving them shall make his/her own determination as to the suitability of the product for his/her particular purpose.	

SAFETY DATA SHEET

1. IDENTIFICATION OF MATERIAL AND SUPPLIER

Product Identifier: Wilclear Sodium Lactate 60% Solution
Other Name(s): sodium lactate
Recommended Use: In-situ Bioremediation
Recommended Restrictions: none known

Supplier Name: JRW Bioremediation, LLC
Address: 14321 W. 96th Terrace
Lenexa, KS 66215
Telephone: 913-438-5544
EMERGENCY Telephone: 800-779-5545 x 116 (Mon-Fri 9am-5pm CST)
913-961-6644 (afterhours)

2. HAZARD IDENTIFICATION

Health & Physical Hazards:
This product contains no substances in their current physical state that are considered to be hazardous to health and has a low order of toxicity. No acute or delayed symptoms or effects have been observed.

Flammability Hazards:
This is a Non-Flammable liquid

Reactivity Hazards:
This product is considered stable. There are no known physical or chemical hazards, incompatibilities, hazardous decomposition or byproducts.

OSHA Hazards: L
This material is not considered hazardous by OSHA. No labels or signage are known to be required.

3. COMPOSITION / INFORMATION ON INGREDIENTS

Components	CAS #	% by Weight	Hazard Classification
Sodium lactate	72-17-3	60%	none
Water	7732-18-5	40%	none

4. FIRST-AID MEASURES

Inhalation:
Inhalation of mist may cause mild irritation of respiratory system. Move to fresh air.

Skin Contact:
In case of contact with skin, immediately wash with plenty of soap and water while removing contaminated clothing. Seek medical attention if skin Irritation develops or persists.

Eye Contact:
In case of contact with eyes, immediately flush eyes with water for at least 15 minutes, lifting eyelids to facilitate irrigation. Get medical attention if necessary.

Ingestion:
If swallowed, rinse mouth. Should symptoms occur, get medical attention.

Signs and symptoms of exposure: None determined. Treat symptomatically.

Medical Conditions aggravated by exposure: None determined. Treat symptomatically.

5. FIRE-FIGHTING MEASURES

Suitable Extinguishing Media: Water, carbon dioxide, foam, or dry chemical.
Unsuitable Extinguishing Media: Do not use heavy water stream as it may spread or scatter.
Specific hazards from substance/mixture: Thermal decomposition may lead to release of irritating or toxic gases and vapors.
General fire hazards: No unusual fire or explosion hazards noted

Special protective equipment / precautions for fire-fighters:
Wear full protective clothing and positive pressure breathing apparatus.

6. ACCIDENTAL RELEASE MEASURES

Methods and Materials for containment and clean up:

Contain spill with absorbent materials such as vermiculite or soil; shovel and place material in drum for disposal. Flush area with water. Surfaces may become slippery after spillage. Dispose of according to all local, state, and federal regulations at an approved waste treatment facility.

Personal precautions / Protective equipment:

Use personal protective equipment. Prevent spills, contamination, and leakage.

Environmental precautions:

No special environmental precautions required.

7. HANDLING AND STORAGE

Precautions for safe handling:

Observe good work and industrial hygiene practices. Use personal protective equipment. Avoid contact with skin, eyes, and clothing. Avoid breathing mists and vapors. Wash hands after use of this product. Do not eat, drink, or smoke while using product. Prevent spills, contamination, and leakage.

Conditions for safe storage, including any incompatibilities:

Keep container tightly closed. Keep in properly labeled containers. Store in a well ventilated, cool, dry area.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Control parameters:	No exposure or biological limits noted for ingredients(s).
Appropriate engineering controls:	Use adequate mechanical ventilation, especially in confined spaces. Local exhaust is recommended. Temperatures best kept below 200^0 C or 390^0 F.

Individual protection measures, such as Personal Protective Equipment (PPE):

Eye/Face protection:	Chemical goggles recommended.
Skin / hand / body protection:	Chemical resistant gloves recommended. Suitable protective clothing as defined by employer.
Respiratory protection:	None required under normal use.
General considerations:	Use good industrial hygiene and best safety practices. When using material, do not eat, drink, or smoke. Remove and wash any contaminated clothing before storage or re-use.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance:	Clear to light yellow
Physical state:	liquid
Odor:	slight to no odor
Odor threshold:	not applicable
pH:	6.0 - 8.5
Melting point/freezing point:	decomposes
Initial boiling point:	221ºF
Closed cup Flash point:	not applicable
Evaporation rate:	not determined
Flammability (solid, gas):	not determined
Upper/lower flammability or explosive limits:	not determined
Vapor pressure (Mg Hg):	not determined
Vapor density (air = 1):	not determined
Density:	1320-1340 kg/m^3
Viscosity	100cP @ 20^0
Molecular Weight:	112.07
Solubility in water:	soluable
Auto-ignition temperature:	not determined
Decomposition temperature:	>200^0 C / >392 ºF
Specific Gravity (H_2O = 1):	1.32 H2O=1 @ 20ºC

10. STABILITY AND REACTIVITY

Reactivity:	Non-reactive under conditions of normal use, storage & transport.
Chemical stability:	Stable under conditions of normal use, storage and transport.
Possibility of hazardous reactions:	
Conditions to avoid:	Temperatures above >200^0 C / >392 ºF
Incompatible materials:	None in particular.
Hazardous decomposition products:	None known.

11. TOXICOLOGICAL INFORMATION

No adverse health effects are expected if the product is used as intended and in accordance with this Safety Data Sheet.

Inhalation: No known effects but if symptoms are experienced, remove source of contamination or move to fresh air.

Ingestion: If swallowed, get medical attention.

Skin: In case of contact with skin, immediately wash with plenty of soap and water while removing contaminated clothing. No known effect but seek medical attention if skin irritation develops or persists.

Eye contact: In case of contact with eyes, immediately flush eyes with water for at least 15 minutes, lifting eyelids to facilitate irrigation. Get medical attention if necessary.

Signs & symptoms of exposure:

Carcinogenicity: Contains no known ingredient listed as carcinogen.
Mutagenicity: No known effect.
Reproductive Toxicity: No known effect.

12. ECOLOGICAL INFORMATION

Ecotoxicity: Product is not considered environmentally hazardous and is not expected to cause significant harm to aquatic, animal, or plant life.
Persistence/degradability: Readily biodegradable.
Bioaccumulative potential: Not expected to bioconcentrate or bioaccumulate.
Mobility in soil: No specific information available.

13. DISPOSAL CONSIDERATIONS

Disposal Methods:

Contain spill with absorbent materials such as clay or soil and shovel and place material in drum for disposal. Surfaces may become slippery after spillage. Dispose of according to all local, state, and federal regulations at an approved waste treatment facility.

14. TRANSPORTATION INFORMATION

DOT hazard class:	Not Applicable, non-regulated
Labeling:	Not Applicable
Proper Shipping Name:	Wilclear® Sodium Lactate 60% Solution
NMFC#:	46400.02
Class	70

15. REGULATORY INFORMATION

Restrictions on use: None.

Other regulations: No information available or not applicable.

16. OTHER INFORMATION

The information in this SDS summarizes to the best of our knowledge at the date of issue, the chemical health and safety hazards of this material and general guidance for safe handling, use, processing, storage, transportation, disposal, and release. This information is not intended to be considered a warranty or quality specifications. The information contained relates only to the specific material designated and may not be valid if used in conjunction with other materials or in any other processes other than intended use. If further clarification or information is required, please contact JRW Bioremediation.

Vitamin B-12

SAFETY DATA SHEET

Section 1: Identification	
Product Name:	EOS® Vitamin B-12 Supplement
Chemical Description:	Solution
Manufacturer:	EOS Remediation 1101 Nowell Road Raleigh, NC 27607 (P): 919-873-2204
Recommended Use:	Groundwater bioremediation (environmental applications)
Restricted Use:	Not for human consumption.
24-Hour Emergency Contact:	ChemTel: United States (P): 800-255-3924 ChemTel: International (P): 813-248-0585

Section 2: Hazard(s) Identification	
Hazard Classification:	Irritant (skin and eye)
Signal Word:	Warning
Hazard Statement(s):	Potential eye and skin irritant.
Pictograms:	
Precautionary Statement(s):	Not for human consumption. Avoid contact with eyes and skin. Wear protective gloves and eye protection. Ingestion of large quantities may cause gastric disturbances.

Section 3: Composition/Information on Ingredients		
Common Name(s)	**CAS NO.**	**% by Weight**
Cyanocobalamin	68-19-9	0.2-0.26
Water	7732-18-5	0.74-0.8

Section 4: First-Aid Measures	
Routes of Exposure	**Emergency First-Aid Procedures**
Inhalation	Remove to fresh air.
Eye Contact	Flush with water for 15 minutes; if irritation persists see a physician.
Skin Contact	Wash with mild soap and water.
Ingestion	Product is non-toxic. If nausea occurs, induce vomiting and seek medical attention.

Section 5: Fire-Fighting Measures	
Extinguishing Media:	CO_2, foam, dry chemical
Special Fire Fighting Procedures:	None
Fire Hazard(s):	None

Section 6: Accidental Release Measures	
Personal Precautions:	Avoid contact with eyes and skin. Do not consume.
Emergency Procedures:	N/A
Methods & Materials used for Containment:	Compatible granular absorbent
Cleanup Procedures:	Spread compatible granular absorbent over spill area and sweep using broom and pan; dispose in appropriate receptacle. Clean area with water.

Section 7: Handling and Storage	
Safe Handling & Storage:	Keep container tightly closed in a dry and well-ventilated place. Protect from sunlight. Recommended storage temperature is 2-8 °C.
Other Precautions:	Consumption of food and beverages should be prevented in work area where product is being used. After handling product, always wash hands and face thoroughly with soap and water before eating, drinking, or smoking.

Section 8: Exposure Controls/Personal Protection		
Exposure Limits		
OSHA PEL:	NE	
ACGIH TLV:	NE	
NIOSH REL:	NE	
Personal Protective Measures		
Respiratory Protection:	Not normally required.	
Hand Protection:	Protective gloves are recommended	
Eye Protection:	Recommended	
Engineering Measures:	Local exhaust ventilation	
Hygiene Measures:	Wash promptly with soap & water if skin becomes irritated from contact.	
Other Protection:	Wear appropriate clothing to prevent skin contact.	

Section 9: Physical and Chemical Properties			
Appearance:	Red Liquid	Explosive Limits:	N/A
Odor:	None	Vapor Pressure:	24 mm Hg
Odor Threshold:	N/A	Vapor Density:	NE
pH:	Neutral	Relative Density:	NE
Melting Point/Freezing Point:	32°F (0°C)	Solubility:	Soluble
Boiling Point:	212°F (100°C)	Partition coefficient:	NE
Flash Point:	NE	Auto-ignition Temperature:	NE
Evaporation Rate:	NE	Decomposition Temperature:	NE
Flammability (solid, gas):	NE	Viscosity:	NE

Section 10: Stability and Reactivity	
Stability:	Stable. Decomposes on exposure to light.
Incompatibility:	Water reactive materials
Hazardous Decomposition Products:	None known
Hazardous Reactions/Polymerization:	Will not occur
Conditions to Avoid:	None known

Section 11: Toxicological Information		
Likely Routes of Exposure:		Ingestion, dermal and eye contact
Signs and Symptoms of Exposure:		None known
Health Hazards		
	Acute:	Potential eye and skin irritant. Ingestion in large amounts may cause gastric disturbances.
	Chronic:	None known
Carcinogenicity		
	NTP:	No
	IARC:	No
	OSHA:	No

Section 12: Ecological Information (non-mandatory)
There is no data on the ecotoxicity of this product.

Section 13: Disposal Considerations (non-mandatory)	
Waste Disposal Methods:	Dispose of according to Federal and local regulations for non-hazardous waste. Recycle, if practical.

Section 14: Transport Information (non-mandatory)
The product is not covered by international regulation on the transport of dangerous goods.
No transport warning required.

Section 15: Regulatory Information (non-mandatory)
N/A

Section 16: Other Information	
Date of Preparation:	21 November 2014
Last Modified Date:	21 November 2014
The information contained herein is based on available data and is believed to be correct. However, EOS Remediation, LLC makes no warranty, expressed or implied, regarding the accuracy of this data or the results to be obtained thereof. This information and product are furnished on the condition that the person receiving them shall make his/her own determination as to the suitability of the product for his/her particular purpose.	

SAFETY DATA SHEET

1. Identification

Product identifier	**RemOx® L ISCO Reagent**
Other means of identification	Not available.
Recommended use	Liquid oxidant recommended for applications that require a concentrated permanganate solution.
Recommended restrictions	Use in accordance with supplier's recommendations.

Manufacturer / Importer / Supplier / Distributor information

Manufacturer/Supplier	CARUS CORPORATION
Address	315 Fifth Street, Peru, IL 61354, USA
Telephone	815 223-1500 - All other non-emergency inquiries about the product should be directed to the company
E-mail	salesmkt@caruscorporation.com
Website	www.caruscorporation.com
Contact person	Dr. Chithambarathanu Pillai
Emergency Telephone	For Hazardous Materials [or Dangerous Goods] Incidents ONLY (spill, leak, fire, exposure or accident), call CHEMTREC at CHEMTREC®, USA: 001 (800) 424-9300 CHEMTREC®, Mexico (Toll-Free - must be dialed from within country): 01-800-681-9531 CHEMTREC®, Other countries: 001 (703) 527-3887

2. Hazard(s) identification

Physical hazards	Oxidizing liquids	Category 2
Health hazards	Acute toxicity, oral	Category 4
	Skin corrosion/irritation	Category 1B
	Serious eye damage/eye irritation	Category 1
	Specific target organ toxicity, single exposure	Category 3 respiratory tract irritation

OSHA defined hazards Not classified.

Label elements

Signal word	Danger
Hazard statement	May intensify fire; oxidizer. Harmful if swallowed. Causes severe skin burns and eye damage. May cause respiratory irritation.

Precautionary statement

Prevention	Keep away from heat. Take any precaution to avoid mixing with combustibles. Keep/Store away from clothing//combustible materials. Use only outdoors or in a well-ventilated area. Do not breathe mist or vapor. Wear protective gloves/protective clothing/eye protection/face protection. Do not eat, drink or smoke when using this product. Wash thoroughly after handling.
Response	In case of fire: Use water for extinction. If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If on skin (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower. Wash contaminated clothing before reuse. If swallowed: Rinse mouth. Do NOT induce vomiting. If inhaled: Remove person to fresh air and keep comfortable for breathing.
Storage	Store locked up. Store in a well-ventilated place. Keep container tightly closed.
Disposal	Dispose of contents/container in accordance with local/regional/national/international regulations.

Hazard(s) not otherwise classified (HNOC) Not classified.

Environmental hazards	Hazardous to the aquatic environment, acute hazard	Category 1
	Hazardous to the aquatic environment, long-term hazard	Category 1

Supplemental information

Hazard symbol

Hazard statement Very toxic to aquatic life with long lasting effects.

Precautionary statement

Prevention Avoid release to the environment.

Response Collect spillage.

3. Composition/information on ingredients

Mixtures

Chemical name	CAS number	%
Sodium permanganate	10101-50-5	36 - 40

Composition comments All concentrations are in percent by weight unless ingredient is a gas. Gas concentrations are in percent by volume.

4. First-aid measures

Inhalation If breathing is difficult, remove to fresh air and keep at rest in a position comfortable for breathing. Remove victim to fresh air and keep at rest in a position comfortable for breathing. Move to fresh air. For breathing difficulties, oxygen may be necessary. Call a physician or poison control center immediately. Get medical attention immediately. Call a physician if symptoms develop or persist. Get medical attention if symptoms persist.

Skin contact Take off immediately all contaminated clothing. (Caution: Solution may ignite certain textiles). Immediately flush skin with plenty of water. Get medical attention immediately. Wash contaminated clothing before reuse.

Contact with skin may leave a brown stain of insoluble manganese dioxide. This can be easily removed by washing with a mixture of equal volume of household vinegar and 3% hydrogen peroxide, followed by washing with soap and water.

Eye contact Immediately flush with plenty of water for up to 15 minutes. Remove any contact lenses and open eyelids wide apart. Continue rinsing. Get medical attention immediately.

Ingestion Immediately rinse mouth and drink plenty of water. Never give anything by mouth to a victim who is unconscious or is having convulsions. Do not induce vomiting. If vomiting occurs, keep head low so that stomach content doesn't get into the lungs. Get medical attention immediately.

Before using, read Material Safety Data Sheet (MSDS) for this product. Rinse container at least three times to an absence of pink color before disposing.

Most important symptoms/effects, acute and delayed Contact with this material will cause burns to the skin, eyes and mucous membranes. Corrosive effects. Irritation of eyes and mucous membranes. Symptoms may include stinging, tearing, redness, swelling, and blurred vision. May cause temporary blindness and severe eye damage. Permanent eye damage including blindness could result. Show this safety data sheet to the doctor in attendance.

Indication of immediate medical attention and special treatment needed Provide general supportive measures and treat symptomatically. In case of shortness of breath, give oxygen. Decomposition products are alkaline. Brown stain is insoluble manganese dioxide.

General information In the case of accident or if you feel unwell, seek medical advice immediately (show the label where possible). If you feel unwell, seek medical advice (show the label where possible). Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves. For personal protection, see Section 8 of the MSDS. Show this safety data sheet to the doctor in attendance. Wash contaminated clothing before reuse.

5. Fire-fighting measures

Suitable extinguishing media Flood with water from a distance, water spray or fog.

Unsuitable extinguishing media The following extinguishing media are ineffective: Dry chemical. Foam. Carbon dioxide (CO2). Halogenated materials.

Specific hazards arising from the chemical May intensify fire; oxidizer. May ignite combustibles (wood, paper, oil, clothing, etc.). Contact with incompatible materials or heat (135 ºC / 275 ºF) could result in violent exothermic chemical reaction. Oxidizing agent, may cause spontaneous ignition of combustible materials. By heating and fire, corrosive vapors/gases may be formed.

Special protective equipment and precautions for firefighters Self-contained breathing apparatus and full protective clothing must be worn in case of fire. Selection of respiratory protection for firefighting: follow the general fire precautions indicated in the workplace.

Fire-fighting equipment/instructions

Move container from fire area if it can be done without risk. Cool containers exposed to flames with water until well after the fire is out. Prevent runoff from fire control or dilution from entering streams, sewers, or drinking water supply. Dike fire control water for later disposal. Water runoff can cause environmental damage.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

Keep unnecessary personnel away. Keep upwind. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Avoid inhalation of vapors and contact with skin and eyes. Wear protective clothing as described in Section 8 of this safety data sheet. Local authorities should be advised if significant spillages cannot be contained.

Methods and materials for containment and cleaning up

Keep combustibles (wood, paper, oil, etc.) away from spilled material. Should not be released into the environment. This product is miscible in water.

Large Spills: Stop leak if possible without any risk. Dike the spilled material, where this is possible. Proceed with either of the following two options depending upon the size of the spill and the availability of the neutralizing agents:

Option # 1: Dilute to approximately 6% with water, and then reduce with sodium thiosulfate, a bisulfite or ferrous salt solution. The bisulfite or ferrous salt may require some dilute sulfuric acid (10% w/w) to promote reduction. Neutralize with sodium carbonate to neutral pH, if acid was used. Decant or filter and deposit sludge in approved landfill. Where permitted, the sludge may be drained into sewer with large quantities of water.

Option # 2: Absorb with inert media like diatomaceous earth or inert floor dry, collect into a drum and dispose of properly. Do not use saw dust or other incompatible media. Disposal of all materials shall be in full and strict compliance with all federal, state, and local regulations pertaining to permanganates.

To clean contaminated floors, flush with abundant quantities of water into sewer, if permitted by federal, state, and local regulations. If not, collect water and treat as described above. Cover with reducing agent (e.g. sodium bisulphite/thiosulphate or a ferrous salt plus 2M H_2SO_4). Transfer to container with water and neutralize with soda ash. Otherwise, absorb spill with vermiculite or other inert material, then place in a container for chemical waste. Do not use sawdust or other combustible material. Following product recovery, flush area with water. Prevent product from entering drains.

Small Spills: Cover with reducing agent (e.g. sodium bisulphite/thiosulphate or a ferrous salt plus 2M H_2SO_4). Transfer to container with water and neutralize with soda ash. Clean surface thoroughly to remove residual contamination.

Never return spills in original containers for re-use. Never return spills in original containers for re-use.

Environmental precautions

Do not allow to enter drains, sewers or watercourses. Contact local authorities in case of spillage to drain/aquatic environment.

7. Handling and storage

Precautions for safe handling

Take any precaution to avoid mixing with combustibles. Keep away from clothing and other combustible materials. Do not get this material in your eyes, on your skin, or on your clothing. Do not breathe mist or vapor. If clothing becomes contaminated, remove and wash off immediately. Spontaneous ignition may occur in contact with cloth or paper. When using, do not eat, drink or smoke. Good personal hygiene is necessary. Wash hands and contaminated areas with water and soap before leaving the work site. Avoid release to the environment.

Conditions for safe storage, including any incompatibilities

Store locked up. Keep container tightly closed and in a well-ventilated place. Store in a cool, dry place. Store away from incompatible materials (See Section 10). Follow applicable local/national/international recommendations on storage of oxidizers. Store in accordance with NFPA 430 requirements for Class II oxidizers.

8. Exposure controls/personal protection

Occupational exposure limits

No exposure limits noted for ingredient(s).

US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000)

Components	Type	Value
Sodium permanganate (CAS 10101-50-5)	Ceiling	5 mg/m3

US. ACGIH Threshold Limit Values

Components	Type	Value	Form
Sodium permanganate (CAS 10101-50-5)	TWA	0.1 mg/m3	Inhalable fraction.
		0.02 mg/m3	Respirable fraction.

US NIOSH Pocket Guide to Chemical Hazards: Recommended exposure limit (REL)

Components	Type	Value	Form
Sodium permanganate (CAS 10101-50-5)	TWA	1 mg/m3	Fume.

US NIOSH Pocket Guide to Chemical Hazards: Short Term Exposure Limit (STEL)

Components	Type	Value	Form
Sodium permanganate (CAS 10101-50-5)	STEL	3 mg/m3	Fume.

Biological limit values No biological exposure limits noted for the ingredient(s).

Exposure guidelines Follow standard monitoring procedures.

Appropriate engineering controls Provide adequate general and local exhaust ventilation. An eye wash and safety shower must be available in the immediate work area.

Individual protection measures, such as personal protective equipment

Eye/face protection Wear safety glasses with side shields (or goggles). Wear face shield if there is risk of splashes.

Skin protection

Hand protection Wear chemical-resistant, impervious gloves. Use protective gloves made of: Rubber or plastic. Suitable gloves can be recommended by the glove supplier.

Other Wear appropriate chemical resistant clothing. Rubber or plastic apron.

Respiratory protection In case of inadequate ventilation or risk of inhalation of vapors, use suitable respiratory equipment. In the United States of America, if respirators are used, a program should be instituted to assure compliance with OSHA 29 CFR 1910.134.

Thermal hazards Wear appropriate thermal protective clothing, when necessary.

General hygiene considerations When using, do not eat, drink or smoke. Keep from contact with clothing and other combustible materials. Remove and wash contaminated clothing promptly. Wash hands before breaks and immediately after handling the product. Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Appearance Dark purple liquid.

Physical state Liquid.

Form Aqueous solution.

Color Dark purple.

Odor Odorless.

Odor threshold Not available.

pH 5 - 8

Melting point/freezing point < 24.8 °F (< -4 °C)

Initial boiling point and boiling range > 213.8 °F (> 101 °C)

Flash point Does not flash.

Evaporation rate As water.

Flammability (solid, gas) Not applicable.

Upper/lower flammability or explosive limits

Flammability limit - lower (%) Not applicable.

Flammability limit - upper (%) Not applicable.

Vapor pressure 760 mm Hg (105 °C)

Vapor density Not available.

Relative density 1.37 - 1.4 (20 °C) (Water = 1)

Solubility(ies) Miscible with water.

Partition coefficient (n-octanol/water) Not available.

Auto-ignition temperature Not available.

Decomposition temperature Not available.

Viscosity Not available.

Other information

Explosive properties	Not explosive. Can explode in contact with sulfuric acid, peroxides and metal powders.
Oxidizing properties	Strong oxidizing agent.

10. Stability and reactivity

Reactivity	The product is non-reactive under normal conditions of use, storage and transport.
Chemical stability	Stable at normal conditions.
Possibility of hazardous reactions	Contact with combustible material may cause fire. Can explode in contact with sulfuric acid, peroxides and metal powders.
Conditions to avoid	Contact with incompatible materials or heat (135 °C / 275 °F) could result in violent exothermic chemical reaction.
Incompatible materials	Acids. Peroxides. Reducing agents. Combustible material. Metal powders.
Hazardous decomposition products	By heating and fire, corrosive vapors/gases may be formed. Contact with hydrochloric acid liberates chlorine gas.

11. Toxicological information

Information on likely routes of exposure

Ingestion	Causes digestive tract burns. Harmful if swallowed. Ingestion causes burns of the upper digestive and respiratory tracts.
Inhalation	May cause irritation to the respiratory system.
Skin contact	Causes severe skin burns.
Eye contact	Causes serious eye damage.
Symptoms related to the physical, chemical and toxicological characteristics	Contact with this material will cause burns to the skin, eyes and mucous membranes. Permanent eye damage including blindness could result.

Information on toxicological effects

Acute toxicity Causes severe skin burns and eye damage. Causes burns. Harmful if swallowed. Health injuries are not known or expected under normal use. Harmful if swallowed.

Components	Species	Test Results
Potassium permanganate (CAS 7722-64-7)		
Acute		
Dermal		
LD50	Rat	2000 mg/kg
Oral		
LD50	Rat	2000 mg/kg

Toxicity data are not available for sodium permanganate. Toxicity is expected to be similar to that of potassium permanganate.

Skin corrosion/irritation	Causes severe skin burns.
Serious eye damage/eye irritation	Causes serious eye damage.
Respiratory sensitization	Not classified.
Skin sensitization	Not classified.
Germ cell mutagenicity	Not classified.
Carcinogenicity	Not classified.
Reproductive toxicity	Not classified.
Specific target organ toxicity - single exposure	May cause irritation of respiratory tract.
Specific target organ toxicity - repeated exposure	Not classified.
Aspiration hazard	Not classified.
Further information	Chronic effects are not expected when this product is used as intended. Prolonged exposure, usually over many years, to manganese oxide fume/dust can lead to chronic manganese poisoning, chiefly affecting the central nervous system.

12. Ecological information

Ecotoxicity Very toxic to aquatic life with long lasting effects.

Components		Species	Test Results
Potassium permanganate (CAS 7722-64-7)			
Aquatic			
Fish	LC50	Bluegill (Lepomis macrochirus)	2.7 mg/l, 96 hours, static
			2.3 mg/l, 96 hours, flow through
			2.3 mg/l, 96 hours
			1.8 - 5.6 mg/l
		Carp (Cyprinus carpio)	3.16 - 3.77 mg/l, 96 hours
			2.97 - 3.11 mg/l, 96 hours
		Goldfish (Carassius auratus)	3.3 - 3.93 mg/l, 96 hours, static
		Milkfish, salmon-herring (Chanos chanos)	> 1.4 mg/l, 96 hours
		Rainbow trout (Oncorhynchus mykiss)	1.8 mg/l, 96 hours
			1.08 - 1.38 mg/l, 96 hours
			0.77 - 1.27 mg/l, 96 hours
		Rainbow trout,donaldson trout (Oncorhynchus mykiss)	0.275 - 0.339 mg/l, 96 hours

Toxicity data are not available for sodium permanganate. Toxicity is expected to be similar to that of potassium permanganate.

Persistence and degradability Expected to be readily converted by oxidizable materials to insoluble manganese oxide.

Bioaccumulative potential Potential to bioaccumulate is low.

Mobility in soil The product is miscible with water. May spread in water systems.

Mobility in general The product is miscible with water. May spread in water systems.

Other adverse effects None known.

13. Disposal considerations

Disposal instructions Dispose of contents/container in accordance with local/regional/national/international regulations.

Local disposal regulations Rinse container at least three times to an absence of pink color before disposing.

Hazardous waste code D001: Ignitable waste
The Waste code should be assigned in discussion between the user, the producer and the waste disposal company.

Waste from residues / unused products Do not allow this material to drain into sewers/water supplies. Dispose of in accordance with local regulations.

Contaminated packaging Since emptied containers may retain product residue, follow label warnings even after container is emptied. Rinse container at least three times to an absence of pink color before disposing. Empty containers should be taken to an approved waste handling site for recycling or disposal.

14. Transport information

DOT

UN number UN3214
UN proper shipping name Permanganates, inorganic, aqueous solution, n.o.s. (Sodium permanganate)
Transport hazard class(es) 5.1
Subsidiary class(es) -
Packing group II
Environmental hazards
Marine pollutant Yes
Special precautions for user Read safety instructions, SDS and emergency procedures before handling.
Special provisions 26, 353, IB2, T4, TP1
Packaging exceptions 152
Packaging non bulk 202
Packaging bulk 242

IATA

UN number UN3214
UN proper shipping name Permanganates, inorganic, aqueous solution, n.o.s. (Sodium permanganate)
Transport hazard class(es) 5.1
Subsidiary class(es) -
Packing group II
Environmental hazards Yes
Labels required 5.1
ERG Code 5L

Special precautions for user Read safety instructions, SDS and emergency procedures before handling.

IMDG

UN number	UN3214
UN proper shipping name	PERMANGANATES, INORGANIC, AQUEOUS SOLUTION, N.O.S. (Sodium permanganate)
Transport hazard class(es)	5.1
Subsidiary class(es)	-
Packaging group	II
Environmental hazards	
Marine pollutant	Yes
Labels required	5.1
EmS	F-H, S-Q
Special precautions for user	Read safety instructions, SDS and emergency procedures before handling.

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code This substance/mixture is not intended to be transported in bulk.

15. Regulatory information

US federal regulations This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.
All components are on the U.S. EPA TSCA Inventory List.

CERCLA/SARA Hazardous Substances - Not applicable.

Drug Enforcement Administration (DEA) (21 CFR 1310.02 (b) 8: List II chemical.

TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)

Not regulated.

US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Not listed.

CERCLA Hazardous Substance List (40 CFR 302.4)

Sodium permanganate (CAS 10101-50-5) LISTED

Superfund Amendments and Reauthorization Act of 1986 (SARA)

Hazard categories Immediate Hazard - Yes
Delayed Hazard - No
Fire Hazard - Yes
Pressure Hazard - No
Reactivity Hazard - No

SARA 302 Extremely hazardous substance No

SARA 311/312 Hazardous chemical Yes

SARA 313 (TRI reporting)

Chemical name	CAS number	% by wt.
Sodium permanganate	10101-50-5	36 - 40
Potassium permanganate	7722-64-7	2

Other federal regulations

Clean Air Act (CAA) Section 112 Hazardous Air Pollutants (HAPs) List

Sodium permanganate (CAS 10101-50-5)

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130)

Not regulated.

Safe Drinking Water Act (SDWA) Not regulated.

Drug Enforcement Administration (DEA). List 2, Essential Chemicals (21 CFR 1310.02(b) and 1310.04(f)(2) and Chemical Code Number

Sodium permanganate (CAS 10101-50-5) 6588

Drug Enforcement Administration (DEA). List 1 & 2 Exempt Chemical Mixtures (21 CFR 1310.12(c))

Sodium permanganate (CAS 10101-50-5) 15 % wt

DEA Exempt Chemical Mixtures Code Number

Sodium permanganate (CAS 10101-50-5) 6588

Food and Drug Administration (FDA) Not regulated.

US state regulations This product does not contain a chemical known to the State of California to cause cancer, birth defects or other reproductive harm.

US. Massachusetts RTK - Substance List

Not regulated.

US. New Jersey Worker and Community Right-to-Know Act

Sodium permanganate (CAS 10101-50-5) 500 lbs

US. Pennsylvania RTK - Hazardous Substances

Not regulated.

US. Rhode Island RTK

Sodium permanganate (CAS 10101-50-5)

US. California Proposition 65

US - California Proposition 65 - Carcinogens & Reproductive Toxicity (CRT): Listed substance

Not listed.

International Inventories

Country(s) or region	Inventory name	On inventory (yes/no)*
Australia	Australian Inventory of Chemical Substances (AICS)	Yes
Canada	Domestic Substances List (DSL)	No
Canada	Non-Domestic Substances List (NDSL)	Yes
China	Inventory of Existing Chemical Substances in China (IECSC)	Yes
Europe	European Inventory of Existing Commercial Chemical Substances (EINECS)	Yes
Europe	European List of Notified Chemical Substances (ELINCS)	No
Japan	Inventory of Existing and New Chemical Substances (ENCS)	Yes
Korea	Existing Chemicals List (ECL)	Yes
New Zealand	New Zealand Inventory	Yes
Philippines	Philippine Inventory of Chemicals and Chemical Substances (PICCS)	Yes
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	Yes

*A "Yes" indicates this product complies with the inventory requirements administered by the governing country(s).
A "No" indicates that one or more components of the product are not listed or exempt from listing on the inventory administered by the governing country(s).

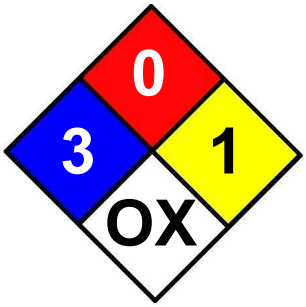
16. Other information, including date of preparation or last revision

Issue date 27-November-2013

Revision date -

Version # 01

NFPA Ratings



References HSDB® - Hazardous Substances Data Bank
Registry of Toxic Effects of Chemical Substances (RTECS)
EPA: AQUIRE database
NLM: Hazardous Substances Data Base
US. IARC Monographs on Occupational Exposures to Chemical Agents
IARC Monographs. Overall Evaluation of Carcinogenicity
National Toxicology Program (NTP) Report on Carcinogens
ACGIH Documentation of the Threshold Limit Values and Biological Exposure Indices

Disclaimer

This safety data sheet was prepared in accordance with the Safety Data Sheet for Chemical Products (JIS Z 7250:2005). The information contained herein is accurate to the best of our knowledge. However, data, safety standards and government regulations are subject to change and, therefore, holders and users should satisfy themselves that they are aware of all current data and regulations relevant to their particular use of product. CARUS CORPORATION DISCLAIMS ALL LIABILITY FOR RELIANCE ON THE COMPLETENESS OR ACCURACY OR THE INFORMATION INCLUDED HEREIN. CARUS CORPORATION MAKES NO WARRANTY, EITHER EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY WARRANTIES OF MERCHANTIABILITY OR FITNESS FOR PARTICULAR USE OR PURPOSE OF THE PRODUCT DESCRIBED HEREIN. All conditions relating to storage, handling, and use of the product are beyond the control of Carus Corporation, and shall be the sole responsibility of the holder or user of the product.

Hazard Communication

CONSTITUENT OF CONCERN	EXPOSURE LIMITS	IDLH (ppm)	SYMPTOMS AND EFFECTS OF EXPOSURE
Tetrachloroethylene (PCE)	PEL = 100 ppm TWA C = 200 ppm (for 5 min. in any 3-hr period) with a max peak of 300 ppm REL = * IP = 9.32 eV **Ca**	150	Acute health effects: Irritation of the skin and eyes, mucous membranes and upper respiratory tract, drowsiness, central nervous system effects resulting in respiratory failure. Long term or repeated exposure may cause dermatitis, effects on the central nervous system resulting in loss of memory and may cause liver and kidney injury.
Trichloroethylene (TCE)	PEL = 100 ppm TWA C = 200 ppm 5-min max peak in any 2-hr period = 300 ppm REL = 25 ppm IP = 9.45 eV **Ca**	1,000	
1,1-dichloroethene (1,1-DCE)	PEL = None REL = * IP = 10.00 eV **Ca**	NL	Acute health effects: Headache, visual disturbance, eye and skin irritation, central nervous system depression, dizziness. Long term effects: Dermatitis, cardiac arrhythmia, liver injury.
trans-1,2-dichloroethene (trans-1,2-DCE)	PEL = 200 ppm TWA REL = 200 ppm TWA IP = 9.65 eV	1,000	Acute health effects: Irritation of the skin, eyes, mucous membranes and upper respiratory tract, dizziness, nausea, vomiting, central nervous system intoxication, drowsiness, weakness, tremor, and cramps. Long term or repeated exposure may affect the liver and kidneys.
cis-1,2-dichloroethene (cis-1,2-DCE)			
Vinyl Chloride	PEL= None REL = * IP = 10.00 eV **Ca**	NL	Abdominal pain, gastrointestinal bleeding, enlarged liver, paralysis of extremities

IDLH = Immediately dangerous to life and health
ppm = parts per million
PEL = Permissible exposure limit (OSHA) is a time-weighted average (TWA) concentration over an 8-hour workday.
REL = Recommended exposure limit (NIOSH) is a TWA concentration over a 10-hour workday
C = Ceiling concentration, not to be exceeded
Ca = Potential occupational carcinogen
IP= Ionization Potential
NL = No limit found in reference materials.
* = Minimize exposure to the lowest feasible limit at all times

Job Hazard Analyses

JOB HAZARD ANALYSIS

JHA Rev.# 000	**Job or Operation Title:** General Site Activities	
Job Location Ameren-Huster Road Substation	**Job Address** 3800 Huster Road; St. Charles, Missouri	**Employees /Subs**
Date JHA Performed 01/11/2022	**Team Performing JHA** Karen O'Shaughnessy	**Verified By** Derek Ingram
Special or Primary Hazards	Vehicular traffic, lifting heavy items, general electrical hazards associated with substation	
Personal Protective Equipment:	**Level D – minimum unless specified otherwise** • Steel Toed Boots (conforms to ANSI Standard Z41) • Hearing Protection (protection up to 95 dBA, as necessary) • Hard hat (as needed) • Eye protection with side shields (ANSI Z-87.1 approved) • Work gloves (leather/cotton - general work) – when handling non-hazardous/ non-contaminated material • Disposable chemical resistant gloves – when handling treatment reagents, contaminated material, and/or hazardous material	

BASIC JOB STEPS	EXISTING AND/OR POTENTIAL HAZARDS	CORRECTIVE MEASURES/CONTROLS

All on-site activities	Slips, trips, and falls	• Mark, identify, or barricade obstructions, tripping hazards, or precipices.
		• Continuously evaluate areas for potential causes of slips/trips/falls.
		• Practice good housekeeping: create walkways, establish proper materials/equipment storage, keep work areas free of debris, materials, tools, etc.
		• Store/maintain equipment and tools in designated areas.
		• Wear properly fitted footwear with proper tread for site conditions.
		• Walk carefully on uneven terrain. Look for changes in grade when walking.
		• Always watch where you are walking; do not read or text while walking.
		• Avoid spilling liquids that can create a slip hazard.
		  ○ If liquids are spilled, clean them up immediately.
		  ○ Use signage to identify wet surfaces/areas.

The following are the basic JHA steps:

1. At earliest possible point (proposal/bidding) list job tasks & steps in the appropriate order.
2. Identify hazards associated with each task/step (possible harm to people, property or environment).
3. Define practical actions to eliminate/minimize hazards/risks to acceptable levels.
4. Ensure all applicable Standard Operating Procedures (SOP) and Cardinal Rules are applied.
5. Communicate JHA to all employees and Subs – Post on Job-site.
6. Update JHA information when conditions, tasks, equipment, etc., change.

All on-site activities (continued)	High/Low Ambient Temperature	• Use buddy system to monitor coworkers for symptoms of heat/cold stress.
		• Wear appropriate clothing to prevent heat exhaustion (light, breathable clothing) or hypothermia (layers of insulating clothing, gloves, and hat, waterproof if necessary).
		• As appropriate, consider the following actions to mitigate environmental factors that can contribute to cold/heat stress:
		  ○ Create a work schedule that limits exposure to heat or cold.
		  ○ Provide an air conditioned or heated space for cooling or warming (as appropriate), such an office trailer or vehicle.
		  ○ In high temperatures, provide shade.
		• Set a frequent break schedule in areas where workers can cool down or warm up, as appropriate.

	Traffic	• Maintain situational awareness. • Wear appropriate high visibility clothing. • Stay in proper line of sight of vehicle operators. • Maintain barricades and signage to direct vehicles away from work areas.
	Insects, snakes, rodents, poisonous plants, and other biological hazards.	• Biological hazards will be addressed in the field, as necessary, through proper identification of the potential hazards. • Identify and avoid working near, walking through, or touching poisonous plants and insect nests. • Site personnel should notify the project manager and other on-site personnel of any allergies to insect stings or severe allergies to poisonous plants before site activities are initiated. • Employees with severe allergies who require medication for severe allergic reactions (such as Epi-pens) are responsible for providing their own medications and should keep medications on hand if the potential for exposure is present.

The following are the basic JHA steps:

1. At earliest possible point (proposal/bidding) list job tasks & steps in the appropriate order.
2. Identify hazards associated with each task/step (possible harm to people, property or environment).
3. Define practical actions to eliminate/minimize hazards/risks to acceptable levels.
4. Ensure all applicable Standard Operating Procedures (SOP) and Cardinal Rules are applied.
5. Communicate JHA to all employees and Subs – Post on Job-site.
6. Update JHA information when conditions, tasks, equipment, etc., change.

All on-site activities (continued)	Inclement weather such as lightning / thunderstorms, heavy rain, high winds / tornado, hail, and snow can create hazardous conditions. • Lightning can result in injuries (electrocution / burns from lightning strike or injury from falling debris) or fire. • Rain or snow can result in slippery conditions, increasing the risk of falls. • High winds can result in flying debris and dust causing injury to personnel and site damage, possibility of personnel being swept off their feet, equipment being blown over.	• Wear appropriate clothing and footwear for weather conditions. • Personnel should be regularly updated regarding any changes to potential weather conditions. • When lightning is seen, count the seconds until thunder is heard and then divide the seconds by **FIVE** to estimate the distance in miles. Follow the 30-30 rule: ○ If you count **30 seconds** or less between seeing lightning and hearing thunder, the lightning is within 6 miles of your location - <u>you are in potential danger and should stop work and seek shelter</u>. ○ Wait **30 minutes** from the last flash of lightning or sound of thunder to establish an "all clear" to return to work. • In high winds: ○ Lower all equipment such as lifts or drill rigs and remove all personnel/ equipment from elevated areas. ○ Tie down and secure all loose equipment ○ Protect your eyes from potential injury from flying debris • If a tornado watch or warning has been issued, take appropriate actions. ○ <u>Evacuate the area immediately if instructed by a regulatory authority or the site safety supervisor</u>. ○ Secure equipment ONLY if there is time that it can be done safely ○ Do not attempt to return to the area until an "all clear" signal has been given by a regulatory authority or the site safety supervisor.
	Electrical hazards associated with site being an operational electrical substation. Hazards range from a small shock to significant electrocutions.	• Stay clear of all electrical lines, panels, and other substation equipment. • Maintain situational awareness and always be conscious of surroundings.

The following are the basic JHA steps:

1. At earliest possible point (proposal/bidding) list job tasks & steps in the appropriate order.
2. Identify hazards associated with each task/step (possible harm to people, property or environment).
3. Define practical actions to eliminate/minimize hazards/risks to acceptable levels.
4. Ensure all applicable Standard Operating Procedures (SOP) and Cardinal Rules are applied.
5. Communicate JHA to all employees and Subs – Post on Job-site.
6. Update JHA information when conditions, tasks, equipment, etc., change.

Lifting and moving materials and/or equipment during all activities	Physical injuries from lifting and moving heavy/ bulky objects	• Evaluate the object/equipment to be moved before attempting to move it.
		  ○ Know how heavy the object is and the effort required to move it.
		  ○ Know if the load can be moved with one person. If not, arrange for assistance.
		• Determine if mechanical assistance can be used. Use material handling equipment for heavy loads such as hand-truck, drum dolly, forklift, or pallet jack.
		• If moving a heavy pallet with a non-motorized pallet jack:
		  ○ Consider using a second person to help start the load moving.
		  ○ Do not jerk or yank the load. Use slow even motions.
		• Avoid tasks that will involve awkward motions such as twisting or lifting a load that is far away from your body. Reconfigure the task to bring loads closer to your body and pivot with feet.
		• Always use proper lifting techniques.
		• Avoid material handling on slippery surfaces. Attempting to "catch yourself" after slipping is a frequent cause of strains.
		• If a load slips out of your hands and is falling, do not try to catch it. Rather, step out of the way.

Equipment receiving and staging	Struck/caught between heavy equipment	• Wear appropriate high visibility clothing. • Ensure clearances for personnel, overhead lines, physical obstacles. • Only experienced and trained operators shall operate motorized equipment. • Inspect fork-lift, hand trucks, pallet jacks prior to use. • Use all equipment according to operator's manual. • Ensure equipment backup warning alarms are functional. • Honk horn when navigating blind corners/intersections. • Personnel will avoid blind side and swing areas. • Make eye contact with operator before approaching equipment.

The following are the basic JHA steps:

1. At earliest possible point (proposal/bidding) list job tasks & steps in the appropriate order.
2. Identify hazards associated with each task/step (possible harm to people, property or environment).
3. Define practical actions to eliminate/minimize hazards/risks to acceptable levels.
4. Ensure all applicable Standard Operating Procedures (SOP) and Cardinal Rules are applied.
5. Communicate JHA to all employees and Subs – Post on Job-site.
6. Update JHA information when conditions, tasks, equipment, etc., change.

JOB HAZARD ANALYSIS

JHA Rev.# 000	**Job or Operation Title:** Groundwater Sampling	
Job Location Ameren-Huster Road Substation	**Job Address** 3800 Huster Road; St. Charles, Missouri	**Employees /Subs**
Date JHA Performed 01/13/2022	**Team Performing JHA** Karen O'Shaughnessy	**Verified By** Derek Ingram
Special or Primary Hazards	Exposure to contaminated groundwater, vehicular traffic, lifting heavy items	
Personal Protective Equipment	**Level D – minimum unless specified otherwise** • Steel Toed Boots (conforms to ANSI Standard Z41) • Hard hat (as needed) • Safety glasses (ANSI Z-87.1 approved) • Work gloves (leather/cotton - general work) – when handling non-hazardous/ non-contaminated material • Chemical-resistant disposable gloves (nitrile) • High visibility safety vests • Tyvek coveralls – as needed when there is a potential for contact with contaminated media	

BASIC JOB STEPS	EXISTING AND/OR POTENTIAL HAZARDS	CORRECTIVE MEASURES/CONTROLS
All on-site activities	Slips, trips, and falls	See JHA for "General Site Activities"
	Insects, snakes, rodents, poisonous plants, and other biological hazards.	
	Inclement weather (lightning/ thunderstorms, heavy rain, high winds / tornado, hail, snow) can create hazardous conditions.	
	High/Low Ambient Temperature	
	Traffic	

The following are the basic JHA steps:

1. At earliest possible point (proposal/bidding) list job tasks & steps in the appropriate order.
2. Identify hazards associated with each task/step (possible harm to people, property or environment).
3. Define practical actions to eliminate/minimize hazards/risks to acceptable levels.
4. Ensure all applicable Standard Operating Procedures (SOP) and Cardinal Rules are applied.
5. Communicate JHA to all employees and Subs – Post on Job-site.
6. Update JHA information when conditions, tasks, equipment, etc., change.

All on site activities (continued)	Electrical hazards associated with site being an operational electrical substation. Hazards range from a small shock to significant electrocutions.	• See JHA for "General Site Activities"
Equipment set up / moving equipment around the site.	Lifting heavy objects (e.g. access covers, well lids, pumps, sampling equipment, coolers, buckets filled with purge water from wells etc.) resulting in muscle strains and/or back injuries.	• Use hand cart or wagon if available. • Use proper lifting techniques when lifting or moving heavy equipment, coolers, buckets, etc. • Avoid tasks that will involve awkward motions such as twisting or lifting a load that is far away from your body. Reconfigure the task to bring loads closer to your body and pivot with feet. • Get help from a co-worker to lift and carry heavy equipment, coolers, buckets of water, etc. • Avoid spilling water that can create mud/slippery conditions.
Groundwater sample collection	Chemical exposure to contaminants in groundwater, chemicals / byproducts in groundwater from current or past remedial activities at the site, and/or sample preservatives.	• Always wear proper PPE including eye protection and chemical-resistant gloves. • Review and understand the SDS for all chemicals of concern in media being collected. • Set up sampling equipment / position body upwind of monitoring well to minimize downwind exposures. • Keep face away from well when opening to avoid exposure to vapors that have accumulated in the well. • Wear proper PPE and handle sample containers carefully to keep groundwater and preservation chemicals off of hands and clothing.

The following are the basic JHA steps:

1. At earliest possible point (proposal/bidding) list job tasks & steps in the appropriate order.
2. Identify hazards associated with each task/step (possible harm to people, property or environment).
3. Define practical actions to eliminate/minimize hazards/risks to acceptable levels.
4. Ensure all applicable Standard Operating Procedures (SOP) and Cardinal Rules are applied.
5. Communicate JHA to all employees and Subs – Post on Job-site.
6. Update JHA information when conditions, tasks, equipment, etc., change.

JOB HAZARD ANALYSIS

JHA Rev.# 000	**Job or Operation Title:** Soil Monitoring and Sampling	
Job Location Ameren-Huster Road Substation	**Job Address** 3800 Huster Road; St. Charles, Missouri	**Employees /Subs**
Date JHA Performed 01/13/2022	**Team Performing JHA** Karen O'Shaughnessy	**Verified By** Derek Ingram
Special or Primary Hazards	Exposure to contaminated soil and vapors, heavy equipment, vehicular traffic	
Personal Protective Equipment	**Level D – minimum unless specified otherwise** • Steel Toed Boots (conforms to ANSI Standard Z41) • Hard hat (as needed) • Safety glasses (ANSI Z-87.1 approved) • Work gloves (leather/cotton - general work) – when handling non-hazardous/ non-contaminated material • Chemical-resistant disposable gloves (nitrile) • High visibility safety vests • Tyvek coveralls – as needed when there is a potential for contact with contaminated soil	

BASIC JOB STEPS	EXISTING AND/OR POTENTIAL HAZARDS	CORRECTIVE MEASURES/CONTROLS
All on-site activities	Slips, trips, and falls	See JHA for "General Site Activities"
	Insects, snakes, rodents, poisonous plants, and other biological hazards.	
	Inclement weather (lightning/ thunderstorms, heavy rain, high winds / tornado, hail, snow) can create hazardous conditions.	
	High/Low Ambient Temperature	
	Traffic	

The following are the basic JHA steps:

1. At earliest possible point (proposal/bidding) list job tasks & steps in the appropriate order.
2. Identify hazards associated with each task/step (possible harm to people, property or environment).
3. Define practical actions to eliminate/minimize hazards/risks to acceptable levels.
4. Ensure all applicable Standard Operating Procedures (SOP) and Cardinal Rules are applied.
5. Communicate JHA to all employees and Subs – Post on Job-site.
6. Update JHA information when conditions, tasks, equipment, etc., change.

All on site activities (continued)	Electrical hazards associated with site being an operational electrical substation. Hazards range from a small shock to significant electrocutions.	See JHA for "General Site Activities"
Equipment set up / moving equipment around the site	Lifting heavy equipment resulting in muscle strains and/or back injuries.	• Use mechanical assistance if needed available. • Use proper lifting techniques when lifting or moving heavy equipment. • Avoid tasks that will involve awkward motions such as twisting or lifting a load that is far away from your body. Reconfigure the task to bring loads closer to your body and pivot with feet. • Get help from a co-worker to lift and carry heavy equipment. • Avoid spilling water that can create mud/slippery conditions.

Soil and air monitoring during site construction activities involving groundbreaking (*).
 	
*Construction activities related to substation operations and not related to site remedial actions.
	Chemical exposure to contaminants in soils, chemicals / byproducts in subsurface from current or past remedial activities at the site, and/or sample preservatives.	• Wear proper PPE including eye protection and chemical-resistant gloves. Wear Tyvek coveralls if there is a potential for contact with contaminated soil.
		• Review and understand the SDS for all site contaminants and chemicals of concern in media being monitored and sampled.
		• Monitor air in breathing zone with a photoionization detector (PID) equipped with an 10.6 electron-volt (eV) bulb to determine the adequacy of the current level of protection relative to existing site conditions.
		  ○ Upgrade PPE, if necessary, as determined by the site safety officer.
		  ○ If hazardous conditions are deemed present, shut down operations and re-evaluate the situation.
		• Visually monitor soils for evidence of potentially high contaminant concentrations (i.e. NAPL).
		• Avoid direct contact with soils.
		• Use engineering controls wherever possible to minimize exposure risk and stand upwind of exposed soils to minimize downwind exposures to soil vapors.
		• Cordon off work area using traffic cones, caution tape, barricading, and signage/placarding to prevent unauthorized personnel from entering a dangerous work area.

The following are the basic JHA steps:

1. At earliest possible point (proposal/bidding) list job tasks & steps in the appropriate order.
2. Identify hazards associated with each task/step (possible harm to people, property or environment).
3. Define practical actions to eliminate/minimize hazards/risks to acceptable levels.
4. Ensure all applicable Standard Operating Procedures (SOP) and Cardinal Rules are applied.
5. Communicate JHA to all employees and Subs – Post on Job-site.
6. Update JHA information when conditions, tasks, equipment, etc., change.

Soil and air monitoring during site construction activities involving groundbreaking (*). *Construction activities related to substation operations and not related to site remedial actions.	Physical injuries caused by soil collapse during trenching and/or excavation	• Loureiro personnel will not enter confined spaces at any time. • Do not enter a trench or excavation that is greater than 4 feet below ground surface. • Do not enter a trench or excavation that has standing water. • Do not enter any trench where the spoils are less than 2 feet from the edge of the excavation.
	Working near heavy equipment	• Establish exclusion zone around the work area using traffic cones, caution tape, barricading, and/or signage and placarding to prevent unauthorized personnel from entering a dangerous work area. • Only trained and authorized personnel may operate heavy equipment and/or assist in equipment moving. • Hard hats and high visibility vests must be worn at all times when working near heavy equipment. • Designate a flag person to facilitate movement of equipment, if necessary. • Make eye contact with equipment operators before approaching operating equipment. • Avoid blind side and swing areas. • Understand and review hand signals.

The following are the basic JHA steps:

1. At earliest possible point (proposal/bidding) list job tasks & steps in the appropriate order.
2. Identify hazards associated with each task/step (possible harm to people, property or environment).
3. Define practical actions to eliminate/minimize hazards/risks to acceptable levels.
4. Ensure all applicable Standard Operating Procedures (SOP) and Cardinal Rules are applied.
5. Communicate JHA to all employees and Subs – Post on Job-site.
6. Update JHA information when conditions, tasks, equipment, etc., change.

Loureiro

JOB HAZARD ANALYSIS		
JHA Rev.# 0	**Job or Operation Title:** Groundwater Extraction System (GETS) Operation and Maintenance	
Location: Ameren – Huster Road Substation	**Job Address** 3800 Huter Road; St. Charles, Missouri	**Employees /Subs**
Date JHA Performed/Updated 01/13/2022	**Team Performing JHA** Karen O'Shaughnessy	**Verified By** Derek Ingram
Special or Primary Hazards	Exposure to contaminated groundwater, vehicular traffic, heavy lifting	
Personal Protective Equipment	**Level D – minimum unless specified otherwise** Steel Toe Boots (conforms to ANSI Standard Z41) Hearing Protection (protection up to 95 dBA, as necessary) Hard hat (as needed) Eye protection with side shields (ANSI Z-87.1 approved) Work gloves (leather/cotton - general work) – when handling non-hazardous material Disposable chemical resistant gloves (nitrile) – when handling hazardous material **Modified Level D – Includes above Level D plus the following:** Tyvek polyethylene-coated coverall or sleeved-apron – as needed when there is a potential for contact with hazardous material Chemical resistant face shield – when opening drums / handling hazardous material	

BASIC JOB STEPS	EXISTING AND/OR POTENTIAL HAZARDS	CORRECTIVE MEASURES/CONTROLS
All on-site activities	Slips, trips, and falls	See JHA for "General Site Activities"
	Insects, snakes, rodents, poisonous plants, and other biological hazards.	
	Inclement weather (lightning/ thunderstorms, heavy rain, high winds / tornado, hail, snow) can create hazardous conditions.	
	High/Low Ambient Temperature	
	Traffic	

The following are the basic JHA steps:

1. At earliest possible point (proposal/bidding) list job tasks & steps in the appropriate order.
2. Identify hazards associated with each task/step (possible harm to people, property, or environment).
3. Define practical actions to eliminate/minimize hazards/risks to acceptable levels.
4. Ensure all applicable Standard Operating Procedures (SOP) and Cardinal Rules are applied.
5. Communicate JHA to all employees and Subs – Post on Job-site.
6. Update JHA information when conditions, tasks, equipment, etc., change.

Daily Operations - Lifting and Moving Materials and/or Equipment	Physical injuries from lifting and moving heavy/ bulky objects	See JHA for "General Site Activities"
LOTO - Lock-Out/Tag-Out	Injury from electrical and pneumatic sources.	Loureiro employee will avoid doing activities that require implementation of LOTO unless absolutely necessary. Employees must be trained and authorized to conduct LOTO, if required.
Daily Operations - General Hand Tool Use	Minor to moderate punctures or laceration caused by damaged or broken hand tools.	See JHA for "General Site Activities"
	Serious injuries caused by using the inappropriate tool for a specific task.	
	Ergonomic related strains caused by swinging hand tools such as hammers / sledgehammers/ mallets. Fatigue and strain caused by using the tool in awkward body positions (reaching, stretching, pushing, pulling).	
	Flying debris (or tool parts) causing foreign body penetration / injury to the body, face, and eyes of the operator and/or other nearby personnel.	
	Serious bodily injury caused by altering or devising a "homemade" tool.	
Daily Operations – Electrical Power Tool Use	Electric shock	See JHA for "General Site Activities"
System Operation, Monitoring, and Equipment Maintenance	Noise levels (**> 85 dbA**) that can result in hearing damage or inability to communicate safety-critical information	Wear hearing protection (plugs or muffs) with NRR (Noise Reduction Rating) of at least 32dB if noise level is above 85 dBA (decibels-time-weighted average).

The following are the basic JHA steps:

1. At earliest possible point (proposal/bidding) list job tasks & steps in the appropriate order.
2. Identify hazards associated with each task/step (possible harm to people, property, or environment).
3. Define practical actions to eliminate/minimize hazards/risks to acceptable levels.
4. Ensure all applicable Standard Operating Procedures (SOP) and Cardinal Rules are applied.
5. Communicate JHA to all employees and Subs – Post on Job-site.
6. Update JHA information when conditions, tasks, equipment, etc., change.

System Operation, Monitoring, and Equipment Maintenance (continued)	Injury caused by mechanical equipment/ moving parts	• Never remove protective covers/guards while equipment is operational. • De-energize all equipment before removing cover/guards. Replace all covers/guards before restarting equipment. • Body parts, loose clothing, hair, jewelry, and foreign objects should be kept from contacting moving parts. • Operators will use appropriate Level D PPE while operating or maintaining the system.
	Release of / exposure to treatment chemicals, untreated water, and wastewater	• Review SDS for all chemicals on site. • Wear proper Level D PPE with additional splash protection (Tyvek coveralls/ splash apron, safety goggles, and face shield) when handling hazardous materials. • Do not break lines when system is under pressure. • Ensure system back-pressure has dissipated before breaking any connections. • Slowly relieve system pressure before breaking piping connections (if necessary). • Immediately clean up any drips or spills in accordance with SDS. • Disconnect equipment from power source when performing maintenance operations. • Visually confirm that all piping connections are secure before powering up equipment and all personnel are away from potential release points. • Do not break lines when system is under pressure. • Confirm that all valves that should be open are open before powering up equipment to avoid rapid, excessive build-up of system backpressure. • Confirm that all valves that should be closed are closed before powering up equipment to avoid accidental release of chemical/ wastewater.

The following are the basic JHA steps:

1. At earliest possible point (proposal/bidding) list job tasks & steps in the appropriate order.
2. Identify hazards associated with each task/step (possible harm to people, property, or environment).
3. Define practical actions to eliminate/minimize hazards/risks to acceptable levels.
4. Ensure all applicable Standard Operating Procedures (SOP) and Cardinal Rules are applied.
5. Communicate JHA to all employees and Subs – Post on Job-site.
6. Update JHA information when conditions, tasks, equipment, etc., change.

System Operation, Monitoring, and Equipment Maintenance (continued)	Release of / exposure to treatment chemicals, untreated water, and wastewater (continued)	**<u>Treatment system will have alarms for any parameter value that is outside of the typical operating range.</u>** The alarms will link to the system controls to prevent a release of treatment chemicals, untreated water, or wastewater (or other problems) by shutting down the relevant system components or the entire system as appropriate. Typical parameters for which alarms are installed include: • High tank levels • High differential pressure across filters • Well vault or building sump water/chemical accumulation • Low water flow in the treatment system • Fire/Smoke Detection • System Shutdown
Filter Change Out	Exposure to contaminants in groundwater, chemicals / byproducts in groundwater from current or past remedial activities at the site, or wastewater/sludge	• Wear proper Level D PPE with additional splash protection (Tyvek coveralls/ splash apron, safety goggles, and face shield) when changing filters. • Do not break lines when system is under pressure. • Ensure system back-pressure has dissipated before breaking any connections. • Slowly relieve system pressure before opening any closed system components/connections (if necessary). • Keep face away when opening filter housing to avoid spray from residual pressure and/or exposure to vapors that have accumulated.
	Heavy lifting resulting in muscle strains and/or back injuries.	• Use proper lifting techniques when lifting spent filters. • Avoid awkward motions such as twisting or lifting a load that is far away from your body. Reconfigure the task to bring loads closer to your body and pivot with feet. • Allow water to drain from filter before pulling filter out of housing to reduce its weight. • Get help from a co-worker to lift spent filters. • Avoid spilling water that can create slippery conditions. • *See JHA for "General Site Activities" for additional corrective measures / controls.*

The following are the basic JHA steps:

1. At earliest possible point (proposal/bidding) list job tasks & steps in the appropriate order.
2. Identify hazards associated with each task/step (possible harm to people, property, or environment).
3. Define practical actions to eliminate/minimize hazards/risks to acceptable levels.
4. Ensure all applicable Standard Operating Procedures (SOP) and Cardinal Rules are applied.
5. Communicate JHA to all employees and Subs – Post on Job-site.
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Loureiro Engineering Associates, Inc.
Standard Operating Procedure
For
Groundwater Sample Collection and Field Analysis

SOP ID: 10004
Date Initiated: 02/20/90
Revision No. 007: 06/11/20

Revised By: */s/ Jo Ann Robertson* **09/25/20**
Jo Ann Robertson **Date**
Technical Associate

Revised By: */s/ Thomas J. Salimeno* **09/25/20**
Thomas J. Salimeno **Date**
Technical Practice Leader

Approved By: */s/ Karen Harris* **01/21/21**
Karen Harris **Date**
Quality Assurance Manager

REVISION RECORD

Rev #	Date	Additions/Deletions/Modifications
Initial Issue	02/20/90	
001-004	NR	No record.
005	01/15/99	No record.
006	12/31/01	Updated to conform the new SOP format. Minor revisions throughout.
007	09/25/20	Text and formatting updates.

Loureiro Engineering Associates, Inc.
Standard Operating Procedure
For
Groundwater Sample Collection and Field Analysis

1. Purpose and Scope

This document describes procedures to be followed for the collection and field measurement of groundwater samples from monitoring wells, Geoprobe® Screen Point Groundwater Sampler or temporary wells. This Standard Operating Procedure (SOP) describes the procedures for the groundwater sample collection using the calculated volume purge method, or non-low flow purge method and the collection of groundwater samples from temporary wells. This SOP does not describe the low-flow sampling method, refer to SOP 10039 – *Low-flow (low-stress) Liquid Sample Collection and Field Analysis* for guidance.

These procedures are not intended to address all potential situations or considerations which may arise in the process of preforming this task. Project-specific sampling precautions, conditions, methods, plans, and strategies will be addressed in the project-specific work plan (Work Plan), Field Sampling Plan (FSP) and/or health and safety documentation. Any variations or deviations to procedures in this document should be discussed with project management and fully documented on the appropriate field forms.

2. Related Standard Operating Procedures

- 10005 – Quality Assurance/Quality Control Measures for Field Sampling Activities
- 10011 – Direct Push Probing and Sample Tooling Advancement
- 10024 – Geoprobe® Screen Point Groundwater Sampler or Temporary Well Installation
- 10038 – Documentation and Integrity of Field Sampling Activities
- 10059 – Management of Investigation Derived Waste
- 10065 – Decontamination of Field Sampling Equipment
- 10067 – Handling, Packaging, and Shipping of Analytical Samples
- 10068 – Groundwater and Non-Aqueous Phase Liquids (NAPL) Measurements

In addition to the above-noted SOPs, project and client-specific requirements may be applicable to individual projects and should be discussed with the Project Manager and incorporated into the Work Plan, FSP, site-specific Health and Safety Plan (HASP), and/or Quality Assurance Project Plan (QAPP) for adherence during the execution of the project.

3. Definitions

Post Run Tubing (PRT): A Geoprobe® proprietary system of tubing and fittings that are used both for vapor[1] and groundwater sampling**.**

1 Vapor sample collection is not covered by this SOP.

Screen Point Groundwater Sampler: A stainless steel, completely sealed groundwater sampler installed using the Geoprobe® or other direct push technology to collect representative groundwater samples from unconsolidated formations.

Temporary well: A slotted well screen placed in a borehole and used to collect grab groundwater samples for screening proposes.

4. Equipment

The following equipment and supplies shall be used during the collection and field analysis of groundwater samples, as required:

- Health and safety equipment (as required by the site-specific HASP)
- Polyethylene plastic sheeting
- Photoionization detector (PID) and calibration kit
- Water quality meters for measuring pH, temperature, specific conductance, oxidation reduction potential (ORP), and dissolved oxygen (DO), calibration solutions and flow-through cell
- Turbidity meter
- Colorimetric tests for dissolved oxygen (DO)
- Temporary well screen (stainless steel or Polyvinyl chloride [PVC])
- Adjustable-rate centrifugal pump, peristaltic pump, bladder pump (constructed of stainless steel or Teflon®), adjustable-rate submersible pump, or adjustable-rate centrifugal pump. The preferable style of pump to be used is project specific and will be determined in the Work Plan or FSP.
- Appropriate tubing for the pump or check valve. Either Teflon or polyethylene tubing may be used for groundwater sampling. Selection of tubing material should be based on the contaminants of concern and the purpose of the groundwater investigation, refer to Work Plan or FSP.
- Bladder pump control units for Nitrogen and Carbon Dioxide Tanks, and electronic and gas operated air compressors (if needed)
- Interface probe/clear view bailer (to check for non-aqueous phase liquids, as appropriate)
- Electronic water-level indicator (accurate to 0.01 foot)
- 0.45 or 10 -micron filter
- Bailer with disposable nylon or polyethylene rope
- 5-gallon bucket or other containers for purged groundwater
- Graduated measuring cup or bucket
- Table or flat surface
- Decontamination tools and fluids
- Traffic cones, caution tape, or barriers
- Cooler and ice
- Field forms
- Laboratory provided sample containers

5. Procedures

5.1. Utilities Clearance

5.1.1. Underground utility clearance will be conducted in accordance with the Loureiro Engineering Associates, Inc. (LEA) ground breaking procedure.

5.2. Site Preparation

5.2.1. Review and follow the health and safety procedures or requirements specified in the site-specific HASP. All necessary personal protective equipment (PPE) shall be donned as specified in the site-specific HASP.

5.2.2. A sufficient area shall be cordoned off using traffic cones, caution tape, or barriers. The area adjacent to the well shall be covered with plastic sheeting to avoid contact with the field equipment and the surface of the ground.

5.3. Equipment Decontamination and Cleaning

5.3.1. All equipment will be decontaminated prior to starting and in between collection of samples in accordance with SOP 10065 Decontamination of Field Sampling Equipment or as otherwise specified in the Work Plan or FSP. Disposable equipment does not need to be decontaminated and will be handled as waste after use.

5.4. Opening monitoring wells and collection of liquid measurements

5.4.1. Refer to SOP 10068 *Groundwater and Non-Aqueous Phase Liquids (NAPL) Measurements* for guidance of the procedure for opening a well and collection of liquid thickness data. If NAPL is observed in a well, contact the project lead to determine if sampling should proceed.

5.5. Analysis of Groundwater Field Parameters using Water Quality Meter

5.5.1. Field parameters including pH, temperature, specific conductance, turbidity, DO, and oxidation reduction potential (ORP). DO may be measured using a water quality meter or colorimetric test kits. The meters shall be calibrated immediately prior to use, if conditions change, and at the end of the day using manufacturer supplied solutions in accordance with the instructions provided by the manufacturer. Calibration information will be recorded on the calibration log.

5.5.2. Collect a water sample for field analysis using a pump or bailer.

5.5.3. Measure field parameters using a water quality meter immediately after the groundwater sample has been collected from the well. Field parameters can also be measured using downhole water quality meters. If you are unsure if the meter can be used in the well, refer to the instruction manual.

5.5.4. The water quality meter shall be placed into a sample and allowed to stabilize for a minimum of twenty seconds. The sample shall be discarded in an appropriate manner (refer to Section 5.11) upon completion of the field analysis. Measurements will be documented in accordance with SOP 10038 *Documentation and Integrity of Field Sampling Activities.*

5.5.5. The water quality meters shall be decontaminated using a distilled/deionized water rinse between each sample or be decontaminated

in accordance with the instrument instructions. To the extent possible, the same water quality meter shall be used for all measurements at a given site for the duration of monitoring at the site. Liquid samples have that been in contact with water quality meters shall not be submitted for laboratory analysis.

5.6. Well Purging

5.6.1. Centrifugal, submersible, Waterra, bladder, inertial, or peristaltic pump, or bailer may be used to purge wells. The selection of the pump will be based well construction, refer to Work Plan for FSP.

5.6.2. Sampling and purging equipment, such as pump, tubing, bailers, containers, etc., shall be placed on polyethylene sheet, never placed on the ground.

5.6.3. Prior to purging the well, use the water level meter or tape measure to measure the total depth of the well to calculate standing water in the well based on the following schedule and record on the appropriate field form:

Well Diameter (inches)	Conversion Factor (gal/feet)
½	0.01
1	0.041
1 ¼	0.064
1 ½	0.091
2	0.163
4	0.654
6	1.47

5.6.4. Prepare pump and tubing for insertion into the well, ensuring that any tubing or pump apparatus is of sufficient length to reach the appropriate depth for pumping. Attached a rope or cord to the top of the pump and use the rope to raise and lower the pump. Do not lower the pump using the tubing.

5.6.5. Pumping shall occur within the well screened interval as indicated on the well construction diagram. If the well construction information is not available, the bottom of the tubing or pump shall be placed 1' - 2' above the bottom of the well. Record the intake depth of the tubing in the field notes.

5.6.6. Measure field parameters (pH, temperature, specific conductance, turbidity, DO, ORP and other water quality parameters) in the well from the first water extracted during the purging process (refer to Section 5.4 for field parameter analysis) and then measure field parameters after each well volume purged. Refer to the Work Plan or FSP for monitoring frequency and list of parameters to monitor.

5.6.7. Purge a volume of water equal to 3 to 5 times the standing water from the well into an appropriate container. Refer to the Work Plan or FSP for purge volume requirements. Measure the pumping rate using a graduated

measure cup or bucket. For slow-yielding wells, decrease the pumping rate to allow for recharge. Refer to the Work Plan or the FSP for purging requirements.

5.6.8. If it is not possible to remove three volumes as described above because the well goes dry, allow for the well to recover and collect the groundwater sample. In slow-yielding wells, whenever full recovery exceeds two hours, the sample shall be extracted as soon as a sufficient volume is available to collect a sample for each parameter.

5.6.9. Well evacuation is deemed to be complete when the following criteria have been met:

- pH measurements vary no more than 0.1 standard units.
- Specific conductance measurements vary no more than 3%.
- Temperature measurements vary no more than 3°Celsius.
- Turbidity measurements are below 5 Nephelometric Turbidity Units (NTUs), if practicable.

Alternatively, well purging shall be deemed complete if a maximum of five well volumes have been removed from the well and/or other site-specific or method-specific parameters have stabilized.

6. Sample Withdrawal

6.1. In order to ensure that the groundwater sample is representative of the formation, it is important to minimize physical alteration (i.e., agitation during purging and/or sample collection) or chemical contamination of the sample during the withdrawal process.

6.2. Samples to be analyzed for the following constituents shall be collected using a peristaltic pump, bladder pump or bailer. If bailer is used for sample collection, gently remove the pump and tubing from the well and slowly lower the bailer into the well and gently remove the bailer. Volatiles can be lost from groundwater samples through agitation.

- Volatile organic compounds (VOCs)
- Purgeable organic carbons (POCs)
- Purgeable organic halogens (POX)
- Total organic halogens (TOX)
- Total organic carbon (TOC)

6.3. To minimize agitation of the water column, samples shall be collected from the pump tubing in the following order into pre-labeled sample containers:

- Extractable organic compounds (semi-volatile)
- Total petroleum hydrocarbons (TPH)
- Polychlorinated biphenyls (PCBs)
- Metals
- Phenols
- Cyanide
- Chloride and sulfate

- Nitrate and ammonia
- Turbidity
- Radionuclides

6.4. Samples shall be obtained from the wells as soon as possible after purging. This may require waiting an extended period for low-yielding wells.

6.5. Samples collected for VOC analysis shall be free of any air bubbles and inverted upon filling.

6.6. Bacterial samples shall be collected using dedicated gloves; taking care not to allow anything to touch the inside of the sampling container. Biological contaminant bottles are sterile, so be careful not to contaminate the bottle by allowing it to come in contact with anything (e.g., sampler or surroundings). Wear gloves and fill the bottle quickly after opening, holding the cap by the edges only. Do not set the cap down on a table or other surface.

6.7. Samples collected for metals analysis (i.e., dissolved metals), which are to be filtered in the field shall be passed through an appropriately sized filter prior to placement in the sample bottle. Pre-rinse the filter with approximately 25 to 50 milliliters of groundwater prior to collecting the samples for filtered metals analyses. Filter sizes will generally be either 10 microns for metals that could be present as colloids, or adsorbed onto colloids that could be mobile in the aquifer, or 0.45 microns for dissolved metals. The appropriate filter size for the individual project must be provided in the Work Plan or FSP. The filter can be used in-line or under negative pressure prior to placement in the sample bottle.

6.8. Measure pH, temperature, specific conductance, DO, ORP and turbidity (and other specific parameters) again after sampling to determine the effectiveness of purging and sample stability.

6.9. Record sampler's name, weather conditions, sampling time, volume of water purged, pumping rate, parameters measured, sample number, and analyses required and all other pertinent information on appropriate field forms in accordance with SOP 10038 Documentation and Integrity of Field Sampling Activities, and complete the chain of custody form as per SOP 10067 Handling, Packaging, and Shipping of Analytical Samples.

6.10. The field paperwork shall also provide an indication of other field conditions that could potentially impact water levels (i.e., major rain storm or snow melt, a pond being drained, or presence of a beaver dam in nearby surface water).

6.11. Do not re-use purging equipment (bailers, rope, tubing, sampling vials, etc.). Any non-disposable bailers shall be returned to the office for decontamination.

6.12. Pumps shall be decontaminated between monitoring wells, in accordance with procedures in SOP 10065 Decontamination of Field Sampling Equipment or as otherwise specified in the site-specific Work Plan or FSP.

6.13. Screen Point Groundwater Sampler and Temporary Well Sampling

6.13.1. There are three methods for collecting groundwater samples from a Screen Point Groundwater Sampler or temporary wells. Refer to SOP 10024 Geoprobe Screen Point Groundwater Sampler or Temporary Well Installation for guidance on installation of the Screen Point Groundwater Sampler or temporary wells. The three methods include the following:

- Bottom Check Valve Sampling
- Sampling Through PRT
- Temporary Well Sampling

6.13.2. Bottom Check Valve Sampling

6.13.2.1. This method is often referred to as "sampling from the open rods," and it can be deployed to pump directly from the bore of the probe rods immediately above the Screen Point Groundwater Sampler using a tubing bottom check valve. This method will be used if the water table is greater than 21 feet. Note that in order for this method to be employed, the piezometric head in the saturated formation must be above the top of the deployed Screen Point Groundwater Sampler; water from the formation must rise into the probe rods where it can then be pumped to the surface. The following procedures are used to obtain groundwater samples using bottom check valve sampling:

6.13.2.2. Place a tubing check valve at the bottom end of a roll of tubing.

6.13.2.3. Push the tubing, check valve end first, down the bore of the probe rods until it strikes the top of the Screen Point Groundwater Sampler.

6.13.2.4. Lift the tubing approximately 4 inches off the bottom (top of the Screen Point Groundwater Sampler) and oscillate.

6.13.2.5. Reduce the pumping rate if air bubbles appearing in the pumped stream indicate that the pumping action is exceeding recharge from the screen point, allowing air to enter at the check valve end.

6.13.2.6. If water cannot be pumped to the surface, sufficient sample may be obtained by using the tubing and check valve as a bailer. Gently oscillate the tubing to fill it with several feet of sample and then remove the tubing from the rods.

6.13.3. Sampling Through PRT

6.13.3.1. Installation of the PRT system will be completed in accordance with SOP 10024 Screen Point Groundwater Sampler or Temporary Well Installation. This tubing is inserted down the rods after the sampler has already been driven to depth and has been deployed for sampling. The top of the Screen Point Groundwater Sampler is equipped with a PRT fitting, which serves as a receptacle for a

corresponding PRT adapter fitted onto the end of the sampling tube. The disadvantage of this method is that it is limited to maximum groundwater depths of 20 to 28 feet below ground surface. The following procedures are used to obtain groundwater samples using PRT fittings and tubing.

6.13.3.1.1. Push the adapter end of the tubing down the bore of the probe rods until it comes into contact with the PRT threads at the top of the Screen Point Groundwater Sampler.

6.13.3.1.2. Rotate the tubing counter-clockwise at the surface to screw the adapter into the screen point threads. Rotate the tubing several revolutions until the downhole adapter is completely seated and the tubing starts twisting.

6.13.3.1.3. The tubing can now be attached to a peristaltic pump or vacuum source at the surface.

6.13.3.1.4. After sampling is complete, tubing should be removed by pulling it up at the surface.

6.13.4. Temporary Well Sampling

6.13.4.1. This procedure is intended to describe the collection of grab groundwater samples from an open borehole using a temporary well. Such a procedure serves to provide “screening level” groundwater data in instances when such data will enhance our understanding of site conditions, and/or in cases where access to the site is limited and other means of conventional groundwater sample collection are not suitable. The borehole will be advanced in accordance with SOP 10011 *Direct Push Probing and Sample Tooling Advancement.* Well screen material and the method of soil boring advancement will be provided in the site-specific Work Plan or FSP. The procedure consists of the following steps:

6.13.4.1.1. Advance soil boring as deep as possible below the top of the water table to loosen the soil.

6.13.4.1.2. Place appropriately selected screen with enough riser attached to reach ground surface into the open borehole. Advance the temporary monitoring point to get as much of the screen below the top of the water table as possible.

6.13.4.1.3. Thread tubing down through the riser and slotted screen into the water column.

6.13.4.1.4. Using a peristaltic pump, purge at least one volume of water corresponding to the volume of disturbed material

around the temporary point (this includes the volume calculated using the borehole diameter).

6.13.4.1.5. Record pH, temperature, specific conductance, and turbidity DO, ORP prior to sampling (Refer to Section 5.4).

6.14. Sample Custody

6.14.1. Sample custody will be managed in accordance with SOP 10067 *Handling, Packaging, and Shipping of Analytical Samples.*

6.15. Waste Management

6.15.1. Investigation derived wastes, including purge water, decontamination liquids, disposable equipment and disposable materials (PPE, plastic sheeting, etc.), will be placed in clearly labeled, appropriate containers in accordance with SOP 10059 Management of Investigation Derived Waste, or managed as otherwise specified in the Work Plan or FSP.

6.16. Documentation

6.16.1. Documentation of field activities will be completed in accordance with SOP 10038 Documentation and Integrity of Field Sampling Activities. In addition, field measurements will be recorded on the Well Sample Record (attached). Any deviations from SOPs will be documented in the field paperwork.

7. References

None.

END OF DOCUMENT

Loureiro Engineering Associates, Inc.
Standard Operating Procedure
for
Quality Assurance/Quality Control Measures
for
Field Sampling Activities

SOP ID: 10005
Date Initiated: 02/20/90
Revision No. 006: 07/28/18

Revised By: ***/s/ Karen A. Goldenberg*** ***07/19/18***
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REVISION RECORD

Rev #	Date	Additions/Deletions/Modifications
Initial Issue	02/20/90	
001-003	-	No record.
004	12/31/01	Updated to reflect new SOP format. Added Section 4.3, Results Evaluation. Minor revisions throughout.
005	11/05/09	Added Section 4.4 on sample management procedures. Revised signature page.
006	07/28/18	Revised to: (1) reference related SOPs, (2) remove performance evaluation (PE) samples and sample management procedures, which are addressed in related SOPs, (3) update and clarify field QA/QC sample types, (4) clarify field QA/QC sample collection methods, (5) include other types of cooler temperature indicators, (6) remove spiked samples prepared outside the laboratory, and (7) reflect new SOP format and language.

Loureiro Engineering Associates, Inc.
Standard Operating Procedure
for
Quality Assurance/Quality Control Measures
for
Field Sampling Activities

1. Purpose and Scope

This document describes procedures to be followed for proper Quality Assurance (QA) / Quality Control (QC) practices, which shall incorporate all activities associated with field measurements and sampling, proper documentation of field and post-field activities, QC sample preparation, chain-of-custody protocol, sample management procedures, and laboratory analytical procedures. The purpose of QA/QC practices is to confirm that Data Quality Objectives (DQOs) are met for a project.

Since a field QA/QC sample may be referred to in different ways, or the same term may be used to refer to different types of QA/QC samples, the names and intended meanings of the field QA/QC samples that may be collected for Loureiro Engineering Associates, Inc. (LEA) projects are provided in Section 3. The use of specific QA/QC measures is project-specific as defined in the project work plan. Similarly, the frequency of QA/QC sample collection is project-specific. Although general guidelines are provided in this SOP, refer to the project-specific work plan or Quality Assurance Project Plan (QAPP) for the types and frequencies of QA/QC samples to be used for a specific project.

2. Related Standard Operating Procedures

- 10030 – Processing Performance Evaluation Samples
- 10038 – Documentation and Integrity of Field Sampling Activities
- 10067 – Handling, Packaging, and Shipping of Analytical Samples

3. Definitions

- Equipment Blank: A sample of analyte-free water poured over or through field sampling equipment. It is collected after completion of decontamination and prior to sampling at another location. The sample accompanies the other field samples to the laboratory for analysis. When used with decontaminated field sampling equipment, the purpose is to assess the adequacy of the decontamination process. May also be called a rinse blank or rinsate blank. When used with disposable sampling

equipment, the purpose is to evaluate contamination introduced from the sampling equipment.

- Field Blank: A generic term for any sample submitted from the field that is identified as a blank. In the context of this SOP, field blank means a sample of media free of measurable contaminants that is exposed to the same field conditions as the field samples and opened in the field for a predefined period of time. Liquid field blanks may also be collected by pouring water free of measurable contaminants from its original container into sample containers in the field. The sample accompanies the other field samples to the laboratory for analysis. The purpose of a field blank is to measure ambient contamination in the field.

- Field Duplicate: A generic term for two (or more) field samples taken at the same time in the same location and are intended to represent the same population. A duplicate may also be referred to as a replicate. In the context of this SOP, "Field Duplicate" means samples that are intended to represent the same population and are taken through all steps of the analytical procedure in an identical manner and provide precision information for the data collection activity. There are two categories of Field Duplicate samples defined by the collection method: co-located Field Duplicates and subsample Field Duplicates.

    - Subsample Field Duplicate: A type of Field Duplicate where the sample is homogenized and then divided into two or more portions so that lab variability can be evaluated. The samples are given independent names so they are not associated with one another by the analytical laboratory (e.g., double blind). Note: Homogenization may have an impact on sample integrity for some sample types (e.g., volatile organic compounds [VOCs] in soil); in these cases, co-located samples may be more appropriate.

    - Co-Located Field Duplicate: A type of Field Duplicate where independent samples are collected as close as possible to the same point in space and time using the same sampling method. They are two separate samples taken from the same source, stored in separate containers, and analyzed independently by the same method and laboratory. Co-located Field Duplicates generally provide more information about the measurement precision of the sampling process, including the sampling equipment and heterogeneity of the site. The samples are given independent names so they are not associated with one another by the analytical laboratory (e.g., double blind).

- Matrix Spike (MS): A type of field duplicate (generic) where the sample is divided into two representative portions taken from one sample in the field. The sample is mixed (except volatiles) prior to division to minimize sample heterogeneity. At the laboratory, known concentrations of certain target analytes are added before sample preparation, cleanup, and determinative procedures have been implemented. The

matrix spike analysis is used to assess the performance of the method by measuring the effects of interferences caused by the sample matrix and reflects the bias of the method for the particular matrix in question.

- Matrix Spike Duplicate (MSD): Additional replicates of matrix spike samples that are subjected to the same sample preparation and analytical scheme as the original sample. The matrix spike duplicate is used to document the precision as well as bias of a method in a given sample matrix.

- Replicate Sample: A type of field duplicate (generic) where the sample is divided into two or more representative portions. The sample is mixed (except volatiles) prior to division to minimize sample heterogeneity. The replicate sample is archived to provide a back-up sample for analysis if the primary sample is damaged during shipment and handling or if lab blanks associated with the analysis of the primary sample show clear evidence of contamination.

- Split Field Sample: A type of field duplicate (generic) where the sample is divided into two or more representative portions taken from one sample in the field and analyzed by at least two different laboratories and/or methods. The sample is mixed (except volatiles) prior to splitting to minimize sample heterogeneity. These samples are used to assess precision variability, and data comparability between laboratories or methods.

- Temperature Blank: A vial of water that accompanies the sample(s) that will be tested upon arrival at the laboratory to ensure that the temperature of the contents of the shipping container were within the required temperature range (generally 4°C ± 2°). Other devices, such as a recording thermometer or temperature strip, may be used in lieu of a temperature blank, providing they monitor the appropriate temperature range.

- Trip Blank: A sample of media free of measurable contaminants taken from the laboratory to the sampling site and returned to the laboratory unopened. A trip blank is used to document contamination attributable to shipping and field handling procedures. Most commonly used for VOC samples. When used for other parameters, it gives a measure of the contamination introduced to a sample by the container (also referred to as a bottle blank). For VOC samples, trip blanks should be prepared at a frequency of one per day of sampling during which samples are collected for VOC samples.

4. Equipment

- Laboratory glassware
- Cooler with identifiable cooler ID
- Chain-of-custody

5. Procedures

5.1. General

5.1.1. All QA/QC sample preparation procedures shall be properly documented including:

- Name of person(s) involved in sample preparation.
- Sample numbers.
- Analyses required.
- Number, type, size of containers used.
- Preservation method.
- Date and time of sample preparation.

5.1.2. All information shall be included in the field logbook and/or appropriate field forms, but not necessarily in the chain-of-custody record except as needed for proper sample identification and analysis. Blind sample numbers are used in order not to disclose the nature of the sample to the laboratory. No information that would identify the sample as a QA/QC sample shall be included in the chain-of-custody record.

5.1.3. At the conclusion of each sampling day, a quality control review shall be conducted using the Field Quality Review Checklist and the Daily Field Report.

5.2. QC Sample Preparation

5.2.1. Trip Blank

5.2.1.1. Trip blanks shall be used when sampling surface water, groundwater, soil, and sediment for VOCs. Trip blank(s) shall be included in each shipping container (cooler) carrying solid and/or liquid matrix samples that are to be analyzed for VOCs.

5.2.1.2. Trip blanks shall be provided by the analytical laboratory, and used only with samples that are to be analyzed for VOCs. **Trip blanks shall not be opened at any time prior to arrival at the laboratory for processing and analysis.**

5.2.1.3. The trip blank samples shall be transported to the field with the sample bottleware. Trip blank samples shall be handled and treated in the same manner as the field samples collected for VOC analysis.

5.2.1.4. For solid-matrix samples collected using the water and methanol preservation methods, unopened vials will be submitted to the laboratory as trip blanks. For solid-matrix samples collected using En Core® containers, two sealed En Core® containers will be submitted to the laboratory as the trip blank sample.

5.2.2. Temperature Blank

5.2.2.1. Temperature blanks shall be used when sampling surface water, groundwater, soil, and sediment. One temperature blank should be included per shipping container (cooler) containing environmental samples.

5.2.2.2. Temperature blanks may indicate if the required temperature range (generally 4°C ± 2°) has been exceeded.

5.2.2.3. Temperature blanks shall be provided by the laboratory and accompany the bottleware to the field.

5.2.2.4. Other devices, such as a recording thermometer or temperature strip, may be used in lieu of a temperature blank, providing the device monitors the appropriate temperature range.

5.2.2.5. The temperature blank or other temperature-indicating device shall be placed in the cooler at the same time as the ice, in preparation for sample collection.

5.2.3. Equipment Blank

5.2.3.1. Equipment blanks shall be used when sampling surface water, groundwater, soil, and sediment. One equipment blank shall be collected for each sample bottle/preservation technique/analysis procedure per matrix per sampling event, or as otherwise specified in project-specific documents

5.2.3.2. The purpose of an equipment/rinsate blank is to determine if decontamination procedures were adequate or if any of the equipment might contribute contaminants to the sample.

5.2.3.3. An equipment blank is prepared by running analyte-free deionized water through all sample collection equipment (bailers, pumps, filters, split-spoon) and placing it in the appropriate sample containers for analysis. If equipment has

been decontaminated in the field, the equipment blank shall be collected after decontamination procedures have been performed before sample collection at the next location. The locations of the samples collected before and after the equipment blank should be recorded on the field paperwork.

5.2.3.4. For certain constituents (e.g., per- and polyfluorinated alkyl substances [PFAS]), the laboratory may need to provide certified analyte-free water for the equipment blank.

5.2.4. Field Blank

5.2.4.1. Field blanks shall be used only when dictated by project-specific DQOs. Refer to project-specific documents for instruction regarding frequency of collection.

5.2.4.2. The purpose of a field blank is to evaluate ambient contamination in the field.

5.2.4.3. This procedure only covers the collection of liquid matrix field blanks. If a solid matrix field blank is needed, project-specific modifications to this procedure will be required.

5.2.4.4. A liquid field blank is prepared by pouring analyte-free deionized water into the appropriate sample containers for analysis at the field sampling location. For certain constituents (e.g., PFAS), the laboratory may need to provide certified analyte-free water for the field blank.

5.2.5. Field Duplicates

5.2.5.1. Subsample field duplicate samples shall be used for soil and sediment samples, unless project-specific documents specify the use of co-located samples. One sample shall be obtained for each sample bottle/preservation technique/analysis procedure per sampling event or one out of every 20 samples, unless co-located samples are used (see below), or as otherwise directed in project-specific documents

5.2.5.2. No information that would identify the sample as a duplicate sample shall be included in the chain-of-custody record.

5.2.5.3. Subsample Field Duplicate Samples

5.2.5.3.1. Subsample field duplicate samples provide precision information on handling, shipping, storage, preparation, and laboratory analysis.

5.2.5.3.2. These are samples that have been divided into two or more portions in the field after the samples have been homogenized. Due to potential VOC loss during homogenization, non-homogenized VOC sampling methods intended to minimize the variability between samples shall be used, as indicated below.

5.2.5.3.3. For soil or sediment VOC samples, collect side-by-side samples from the sampling device (e.g., core, auger). For non-VOC samples, collect twice as much volume as is normally collected. Homogenize the sample well before filling the sample jars.

5.2.5.3.4. For aqueous VOCs samples, fill the sample vials from the same bailer or consecutively from the same tubing. For non-VOC samples, alternate filling bottles from the sampling device (e.g., bailer, pump). For example, VOCs for the primary sample, VOCs for the duplicate sample, SVOCs for the primary sample, SVOCS for the duplicate sample, etc.

5.2.5.4. Co-located Field Duplicate Samples

5.2.5.4.1. Co-located field duplicate samples provide precision information on the sampling process, including the sampling equipment and heterogeneity of the site.

5.2.5.4.2. For soil or sediment, co-located samples shall be collected from adjacent surface locations or at the same depth interval from side-by-side boreholes.

5.2.5.4.3. For aqueous samples, co-located samples shall be collected by filling all of the sample bottles for the primary sample, then filling all of the sample bottles for the co-located sample.

5.2.6. Split Samples and Replicates

5.2.6.1. These samples shall be used only when dictated by project-specific DQOs. Refer to project-specific documents for instruction regarding frequency of collection. Sample collection follows the same procedures as indicated for subsample field duplicate samples above.

5.2.6.2. Split Samples

5.2.6.2.1. Split samples provide information to assess precision variability, and data comparability between laboratories or methods.

5.2.6.2.2. For soil or sediment VOC samples, collect side-by-side samples from the sampling device (e.g., core, auger). For non-VOC samples, collect twice as much volume as is normally collected. Homogenize the sample well before filling the sample jars.

5.2.6.2.3. For aqueous VOCs samples, fill the sample vials from the same bailer or consecutively from the same tubing. For non-VOC samples, alternate filling bottles from the liquid sampling device (e.g., bailer, pump). For example, VOCs for the primary sample, VOCs for the duplicate sample, SVOCs for the primary sample, SVOCS for the duplicate sample, etc.

5.2.6.3. Replicate Samples

5.2.6.3.1. Replicate samples provide a back-up sample for analysis, if needed.

5.2.6.3.2. For soil or sediment VOC samples, collect side-by-side samples from the sampling device (e.g., core, auger). For non-VOC samples, collect twice as much volume as is normally collected. Homogenize the sample well before filling the sample jars.

5.2.6.3.3. For aqueous VOCs samples, fill the sample vials from the same bailer or consecutively from the same tubing. For non-VOC samples, alternate filling bottles from the liquid sampling device (e.g., bailer,

pump). For example, VOCs for the primary sample, VOCs for the duplicate sample, SVOCs for the primary sample, SVOCS for the duplicate sample, etc.

5.2.7. Matrix Spike/Matrix Spike Duplicate Samples

5.2.7.1. MS/MSD samples shall only be used when dictated by project-specific DQOs. Refer to project-specific documents for sample frequency.

5.2.7.2. Aqueous samples are collected from one sampling location at triple the normal sample volume. In the filling sequence for aqueous MS/MSD samples, bottles will alternate (e.g., VOCs for the primary sample, VOCs for the MS, VOCs for the MSD, SVOCs for the primary sample, SVOCS for the MS, SVOCs for the MSD, etc.).

5.2.7.3. Solid samples are collected from one sampling interval at double or triple the normal sample volume. For VOCs, triple side-by-side samples should be collected. For non-VOC samples, collect twice as much volume as is normally collected. Homogenize the sample well before filling the sample jars.

5.2.7.4. Identify the MS/MSD on the chain-of-custody form by adding "MS/MSD" after the sample number.

5.3. QA/QC Sample Result Evaluation

The analytical results on QA/QC samples should be evaluated along with the remaining analytical data as follows:

5.3.1. No constituents should be detected in the trip blank, equipment blank, or field blank.

5.3.2. The relative percent differences (RPDs) shall be computed for all constituents detected in subsample and co-located duplicate samples used. If split samples are used to evaluate different laboratories or methods, the RPDs shall be computed for all constituents detected in both the sample and split sample.

The RPD between two measurements (e.g., M1 and M2) is calculated as follows:

$$RPD = \frac{|\ M1\ -\ M2\ |}{(\ M1\ +\ M2\ )/\ 2}\ x\ 100\%$$

5.3.3. Refer to project-specific documents for evaluation of MS/MSD sample results.

6.0 References

EPA, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (SW-846) Chapter 1, Revision 2. July 2014

EPA, *Uniform Federal Policy for Quality Assurance Project Plans, Part 2B, Quality Assurance/Quality Control Compendium: Minimum QA/QC Activities*, EPA Publication: EPA-505-B-04-900B.

ASTM, *Standard Guide for Field Quality Assurance in a Groundwater Sampling Event*, ASTM D7069 (2015), January 2015.

END OF DOCUMENT

Loureiro Engineering Associates, Inc.
Standard Operating Procedure
for
Soil Sampling

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REVISION RECORD

Rev #	Date	Additions/Deletions/Modifications
Initial Issue	02/20/90	
001-004	-	No record.
005	07/19/00	Revisions to template, including new logo.
006	05/16/01	Revisions to Sections 4.2.1, 4.2.2; add Section 4.2.3.
007	07/27/01	Updated to conform with new SOP format.
008	12/31/01	Minor revisions throughout.
009	01/18/06	Removed use of wood spatula
010	07/17/18	Revisions throughout. Update to reflect new SOP format and updated sampling methodologies.
011	09/12/18	Added text to Section 5.4 to clarify sample recovery requirements and photographing soil samples

Loureiro Engineering Associates, Inc.
Standard Operating Procedure
for
Soil Sampling

1. Purpose and Scope

This document discusses procedures for collection of soil samples for analysis. Methods for collection and quality assurance/quality control (QA/QC) requirements are covered under separate standard operating procedures (SOPs). The procedures outlined in this document are in accordance with Environmental Protection Agency (EPA) document entitled, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (SW-846). The collection of soil and sediment samples for analysis of Volatile Organic Compounds (VOCs) is not covered in this SOP, refer to SOP 10057 *Collecting and Preserving Soil and Sediment Samples for Laboratory Determination of Volatile Organic Compounds (VOCs*).

2. Related Standard Operating Procedures

- 10005 – QA/QA Measures for Field Sampling Activities
- 10015 – Geologic Logging of Unconsolidated Sedimentary Deposits
- 10038 – Documentation and Integrity of Field Sampling Activities
- 10057 – Collecting and Preserving Soil and Sediment Samples for Laboratory Determination of Volatile Organic Compounds (VOCs)
- 10059 – Management of Investigation Derived Waste
- 10065 – Decontamination of Sampling Equipment
- 10066 – Sediment Sampling Using Vibratory Corer

In addition to the above-noted SOPs, project and client-specific requirements may be applicable to individual projects and should be discussed with the Project Manager and incorporated into the project-specific work plan (Work Plan) or Field Sampling Plan (FSP) for adherence during the execution of the project.

3. Definitions

Scale: A linear scale, also called a bar scale, scale bar, graphic scale, or graphical scale, is a means of visually showing scale in photograph.

4. Equipment

The following equipment and supplies shall be used during soil sampling activities, as required:

- Health and safety equipment (as required by the site-specific Health and Safety Plan [HASP])
- Polyethylene or stainless steel spatula (spoon, scoop, trowel, Terra Core™, EnCore®, etc.) for transfer of soil from sample collection device to sample container
- Soil collection devices will be identified in the site-specific Work Plan, but may include polyethylene or stainless steel hand augers, trowel, trier, soil coring device, direct push, spilt-spoon sampler, bobcat, excavator, etc.
- Latex or nitrile gloves
- Polyethylene plastic sheeting
- Table or flat surface
- Measuring tape and scale
- Paper towels
- Balance for weighing samples
- Utility knife
- Re-sealable plastic bags
- Photoionization Detector (PID) and calibration kit
- Bowl/bucket/container for compositing sample (of appropriate material)
- Traffic cones, caution tape or barriers
- Camera
- Cooler
- Ice
- Laboratory provided containers

5. Procedures

5.1. Utilities Clearance

Underground utility clearance shall be conducted in accordance with the LEA ground breaking procedure.

5.2. Site Preparation

5.2.1. Review and follow the health and safety procedures or requirements specified in the site-specific HASP. All personal protective equipment (PPE) shall be donned as specified in the site-specific HASP during all sampling procedures.

5.2.2 A sufficient area shall be cordoned off using traffic cones, caution tape, or barriers to restrict access to the work area.

5.2.3 A level table shall be placed in the vicinity of the sample collection location and covered with polyethylene sheeting.

5.2.4 Decontaminated soil sampling devices and spatulas shall be placed on the table or flat surface. Sample bottles shall be placed in a convenient location and in order of sample collection.

5.2.5 PID and plastic bags shall be placed on the table for VOC screening, if necessary.

5.3. Equipment Decontamination and Cleaning

All equipment will be decontaminated prior to starting and in between collection of samples in accordance with SOP 10065 *Decontamination of Field Sampling Equipment* or as otherwise specified in the project-specific Work Plan or FSP.

5.4. Sampling Procedures

Tools and procedures for collecting soil samples depend on the desired depth of sample. The sample will be rejected if recovery is less than 80% or sample recovery requirements specified in the work plan or FSP are not met. If the sample is rejected, an additional attempt will be made. Document the location of soil boring attempts on a map (tape off existing/permanent features or use a GPS).

5.4.1. The particular soil collection device (i.e., hand auger, split spoon, etc.) shall be retrieved from the point of collection and placed on a level table covered in polyethylene sheeting.

5.4.2 Photograph the sample with a scale (if allowed).

5.4.3 Soil samples for analysis of VOCs will be collected immediately and will be collected from an undisturbed area of the soil sample.

5.4.2. Based on analytical and project requirements, soil will be transferred directly into a container to be homogenized. Materials placed in the

container (e.g, an aluminum pan [or bowl of alternate material], ziplock bag) will be homogenized by hand (mixed and/or kneaded) until uniform in color and texture. Care should be taken to fill sample containers with the appropriate mass and/or volume for the desired analysis. Large void spaces within the container shall be minimized by packing, not agitation.

5.4.4 Wipe the rim of the sample container with a clean paper towel to remove excess solids, which would prevent adequate sealing of the sample container, and seal the container.

5.4.5 The order of sample collection shall be based on the work plan/FSP.

5.4.6 Place and secure sample within cooler and complete all sample collection documentation including logging of soil utilizing SOP 10015 *Geologic Logging of Unconsolidated Sedimentary Deposits*. The cooler should not be left unattended without a custody seal.

5.4.7 If required by the site-specific Work Plan, place stake or flagging in sampling location.

5.5. Post Sampling Procedures

As required, upon completion of all sampling procedures for a particular site, secure the lid of the cooler using packaging tape with the chain of custody inside in accordance with SOP 10067 *Handling, Packing, and Shipping of Analytical Samples.*

5.6. Waste Management

Investigation derived wastes (IDW), including soil cuttings, decontamination liquids, and disposable materials (PPE, plastic sheeting, etc.) will be placed in clearly labeled, appropriate containers in accordance with SOP 10059 *Management of Investigation Derived Waste*, or managed as otherwise specified in the work plan/FSP.

5.7. Documentation

5.7.1. Documentation of field activities will be completed in accordance with SOP 10038 *Documentation of Field Sampling Activities and* 10015 *Geologic Logging of Unconsolidated Sedimentary Deposits.*

5.7.2. In general, the following field forms are required for collection of soil samples:

- Daily Field Report
- Daily Field Report "Supplemental Sheet"
- Daily Field Report "Calibration Record" (if PID or balance were used)
- Field Sampling Record "Miscellaneous Samples"
- Field Boring Log
- Chain of Custody

5.7.3. The following general information shall be recorded in the field log book and/or on the appropriate field forms:

- Name of recorder
- Identification of borings
- Collection method
- Date and time of collection
- Types of sample containers used, sample identification numbers and QA/QC sample identification
- Preservative(s) used
- Parameters requested for analysis
- Field analysis method(s)
- Field observations on sampling event
- Name of collector
- Climatic conditions, including air temperature
- Investigation derived waste (IDW)
- Field Sketch of sample location and color/type of flagging (as needed)
- Coordinates and elevations of soil sample locations

6. References

EPA. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846).*

Terra Core ™. *Terra Core ™ Sampling Guidance. ALS Global. Accessed 2/19/2018.*

EnCore®. *EnCore® Sampler Sampling Procedures. En Novative Technologies, Inc., 2013.* Accessed 2/19/2018.

END OF DOCUMENT

Loureiro Engineering Associates, Inc.
Standard Operating Procedure
for
Installation of Non-Water Supply Wells
and
Piezometers in Unconsolidated Deposits

SOP ID: 10007A
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REVISION RECORD

Rev #	Date	Additions/Deletions/Modifications
Initial Issue	02/20/90	
001-004	-	No record.
005	12/31/01	Formatting and minor revisions throughout.
006	08/12/02	Added section on utility clearance.
007	11/01/12	Reference was provided to the company's updated Groundbreaking Procedure, (dated December 6, 2011). The requirement for a site-specific HASP and JHA It was also noted that surging and pumping at the same time may not be as effective as surging and then pumping. Table 1 was incorporated describing and assessing well development equipment. Finally, Figures 1 and 2 were revised to reflect current practices for monitoring well installation.
008	07/18/18	Revisions throughout. Update to reflect new SOP format. Checked against up-to-date standards. Divided installation and development into two separate SOPs: SOP 10007A *Installation of Non-Water Supply Wells and Piezometers in Unconsolidated Deposits* and SOP 10007B Development *of Non-Water Supply Wells and Piezometers in Unconsolidated Deposits*. Sampling methodologies were updated.
009	09/07/18	Added nomenclature section.

Loureiro Engineering Associates, Inc.
Standard Operating Procedure
for
Installation of Non-Water Supply Wells
and
Piezometers in Unconsolidated Deposits

1. Purpose and Scope

This standard operating procedure (SOP) is designed to describe the proper methods and procedures to be used to install wells and piezometers in water-table aquifers and unconsolidated deposits. Because each site is unique and the purpose of the monitoring wells may vary from installation to installation, no definitive rules can be established. Throughout this SOP, reference to monitoring wells is also intended to mean piezometers, unless specifically indicated otherwise. This SOP applies to monitoring wells and piezometers installed by both manual and by Geoprobe® or similar direct push technologies.

2. Related Standard Operating Procedures

- 10005 – Quality Assurance/Quality Control Measures for Field Sampling Activities
- 10015 – Geologic Logging of Unconsolidated Sedimentary Deposits
- 10038 – Documentation and Integrity of Field Sampling Activities
- 10059 – Management of Investigation Derived Waste
- 10065 – Decontamination of Field Sampling Equipment

In addition to the above-noted SOPs, project and client-specific requirements may be applicable to individual projects and should be discussed with the Project Manager and incorporated into the project specific work plan (Work Plan) for adherence during the execution of the project.

3. Definitions

- Geoprobe®[1] or similar direct push technologies: A vehicle-mounted, hydraulically-powered, soil probing machine that utilizes static force and percussion to advance small diameter sampling tools into the subsurface for collecting soil cores, soil gas, or

1 Geoprobe® is a registered trademark of Kejr Engineering, Inc., Salina, Kansas

groundwater samples. Throughout this SOP, reference to Geoprobe® includes similar direct push technologies, unless specifically indicated otherwise.

- Prepacked Well Screen (0.5 in and 1.5 in): An assembly consisting of a slotted polyvinyl chloride (PVC) pipe surrounded by environmental grade sand contained within a stainless steel wire mesh cylinder. The inner component of the prepacked screen is a flush-threaded, 0.5 inch Schedule 80 PVC pipe with 0.01 inch slots. (Alternatively, a 1.5 inch Schedule 80 PVC pipe can be used). Stainless steel wire mesh with a pore size of 0.011 inches makes up the outer component of the prepacked screen. The space between the inner slotted pipe and outer wire mesh is filled with 20/40 mesh silica sand. Geoprobe® prepacked screens are available in sections of various lengths (3 feet or 5 feet) and a nominal inside diameter of 0.5 in or 1.5 in.

- Cement-Bentonite Grout: mixture of 95 pounds of Type II Portland cement, 4 to 6 pounds of powdered sodium bentonite, and 5 gallons of potable water. The bentonite must be thoroughly mixed with the water *before* the cement is added.

- Filter Pack Sand: all filter pack sand shall have an average specific gravity of 2.5 with not more than 1% of the material having a specific gravity less than 2.25. Thin, flat or elongated particles shall not exceed 2% of the material, no more than 5% of the material shall be soluble in hydrochloric acid, and the material shall be washed and free of shale, mica, clay, dirt, loam, and organic impurities.

4. Equipment

The following equipment and supplies shall be used during monitoring well installation activities, as required:

- Health and safety equipment (as required by the site-specific Health and Safety Plan [HASP])
- All necessary permits and licenses
- Soil Color Chart
- Hand len
- Drilling rig
- Hand Auger
- Monitoring well casing
- Monitoring well slotted screen or Geoprobe® Pre-pack screen
- Bottom caps, plugs, or points
- Centering guides (if they are to be used)
- Bentonite chips
- Cement-bentonite grout

- Grout pump with mechanical mixing ability (if warranted)
- Filter pack sand
- Protective casing or road box
- American lock(s) and keys
- Weighted ape measure
- Electronic water-level indictor (accurate to 0.01 foot)
- Field forms or field book
- Caution tape, traffic cones, or barriers
- Polyethene plastic sheeting
- Table or flat surface
- Soil sampling tools, laboratory containers, cooler, and ice, if needed
- Decontamination fluids
- Camera/tablet

5. Procedures

5.1. Utilities Clearance

Underground utility clearance will be conducted in accordance with the LEA ground breaking procedure.

5.2. Site Preparation

5.2.1. Review and follow the health and safety procedures or requirements specified in the site-specific HASP. All personal protective equipment (PPE) shall be donned as specified in the site-specific HASP.

5.2.2. A sufficient area shall be cordoned off using caution tape, traffic cones or barriers to restrict access to the work area.

5.2.3. The area adjacent to the proposed borehole may be covered with 5-mil plastic sheeting (depending on site-specific needs). If sheeting is used, soil cuttings shall be placed on the plastic sheeting to avoid contact with the groundsurface.

5.3. Equipment Decontamination and Cleaning

All equipment will be decontaminated prior to starting and in between well installation in accordance with SOP 10065 *Decontamination of Field Sampling Equipment* or as otherwise specified in the site-specific WP/FSP.

5.4. Borehole Advancement

5.4.1. The borehole will be advanced using the Geoprobe® the steel casing to the specified depth. Hand augers may be used if it is not possible to access the location using the Geoprobe®.

5.4.2. Soil samples will be collected during borehole advancement and described in accordance with SOP 10015 *Geologic Logging of Unconsolidated Sedimentary Deposits* and documented in accordance with SOP 10038 *Documentation and Integrity of Field Sampling Activities*.

5.4.3. If the borehole has been drilled to a depth greater than that at which the well is to be set, the borehole must be backfilled with bentonite pellets, bentonite chips, or a cement-bentonite grout slurry to a depth of approximately one foot below the intended well depth. A grout pump may be needed to prevent voids in the grout or dilution of the grout. Approximately one foot of clean sand must be placed on top of the backfill to return the borehole to the proper depth for the well installation.

5.5. Installation of Well Screen and Casing

The appropriate lengths of well screen (with bottom cap, or plug, or well point) and casing must be joined watertight and carefully lowered inside the drill stem to the bottom of the borehole. If centering guides are used, they must be placed at intervals around the well casing, beginning no lower than 5 feet above the top of the screen.

5.6. Design and Installation of the Filter Pack

After the well screen and casing are installed in the borehole, the filter pack shall be installed. For monitoring wells in unconsolidated materials, the selection of the appropriate filter pack material shall be based upon project specific parameters and any state or local guidance, or applicable regulatory requirements.

A filter pack of clean silica sand will be placed around the well screen. Place the filter pack into the borehole at a uniform rate in a manner that will allow even placement of the sand. The drill stem shall be raised slowly while the sand is being placed to avoid caving of the borehole walls; the drill stem shall never be raised above the top of the filter pack during installation. Using a weighted tape (stainless steel weight on the end of a measuring tape), continuously sound the top of the filter pack as it is being installed. The filter pack shall extend from a depth of approximately one foot below the screened interval to a minimum height of one

to two feet above the top of the well screen. However, this length may be adjusted if it would create the potential for cross-contamination or in the case of shallow water tables.

A finer-grained sand cap shall be installed for a minimum of one foot above the filter pack. This height may also be adjusted in the case of shallow water tables.

5.7. Geoprobe® Prepacked Screen Monitoring Well Installation

The installation of prepacked screen monitoring wells in general follows the following four steps (Figure 2):

5.7.1. Anchoring the Well Assembly at Depth

In the first step, an expendable anchor point is driven to the desired depth on the end of a 2.25 inch outside diameter probe rod string. A prepacked screen assembly is inserted into the inside diameter of the rod string with 5-foot sections of PVC riser. The screens and riser pipe are attached to the anchor point via a snap-lock connector. If the monitoring well is to have a flush-mount finish, it is suggested to prepare a large enough hole to accept a standard well protector before driving the probe rods.

5.7.2. Providing a Sand Pack and Grout Barrier

The natural formation will sometimes collapse around the well screens as the probe rod string is withdrawn. This is frequently encountered in sandy formations below the water table. This provides an effective barrier between the screens and grout material used to seal the well annulus. If the formation does not collapse, a sand barrier must be placed from the surface while retracting the well casing. This procedure needs to be followed carefully to prevent the grout from reaching the well screens, potentially giving rise to non-representative samples.

Using a flat tape measure, determine the depth from the top of the PVC riser to the bottom of the annulus between the riser and probe rods. If unstable conditions have resulted in formation collapse (measured depth of 2 to 3 feet), then proceed to 5.7.4. If the borehole has not collapsed, then retract the casing to 1 foot above the screen while adding sand. Take measurements with a weighted tape. Continue until 2 feet of sandpack have been established above the well screen.

5.7.3. Installation of Impermeable Seal

An impermeable seal at least two feet thick must be placed on top of the fine sand cap. The seal may be composed of either bentonite pellets or bentonite slurry. The thickness of the bentonite seal may be adjusted for wells completed in aquifers with shallow water tables. The pellets must be placed into the borehole in a slow and continuous manner that prevents bridging. This is especially important in deeper monitoring wells where the pellets may have to be emplaced through a considerable depth of standing water in the borehole.

The bentonite slurry shall be prepared by mixing approximately 2 pounds of bentonite per one gallon of water. The slurry shall be emplaced in the borehole via a tremie pipe. The tremie pipe must be plugged on the bottom and have openings along the sides of the bottom one foot of pipe. This will allow the slurry to be emplaced into the borehole without disturbing the fine sand cap. This procedure is especially important for the relatively deeper wells.

Verify the position of the top of the bentonite seal using a weighted tape measure. If all or a portion of the bentonite seal must be emplaced above the water table, hydrate the bentonite with clean water. Allow 30 minutes after adding the water for the bentonite to hydrate.

5.7.4. Installation of Grout Backfill

Place an annular seal of cement-bentonite grout above the bentonite seal. Install the cement-bentonite grout continuously from the bottom of the annular space to the ground surface through a tremie pipe. The tremie pipe must be plugged on the bottom and have openings along the sides of the bottom one-foot length of pipe. This will allow the grout to be emplaced into the borehole without disturbing the bentonite seal. Alternatively, a bentonite slurry can be used.

5.8. Surface Completion

All monitoring wells will be finished at the surface with a concrete pad (Figure 1). The concrete pad shall typically be two-feet square and at least four inches thick. The concrete shall fill the borehole to a depth below the frost line. The pad shall be constructed in one continuous pour of concrete. Note that some of the cement-bentonite grout used for the annular seal may have to be removed to install the

concrete pad. A survey pin may be installed in the concrete pad before it dries, if necessary.

For monitoring wells that will be completed above-grade, a locking steel protective casing shall be installed in the concrete. The protective casing shall extend at least three feet into the ground and two feet above ground. For monitoring wells that will be completed flush, a steel roadbox, suitable for traffic loads, with a gasketed cover shall be installed.

All monitoring wells shall be locked upon completion of installation.

5.9. Nomenclature

The well identification guidance will be provided in the Work Plan. The following standard naming guild lines:

- "R" will only be added to the end of a well identification if the well is a replacement for a destroyed or abandoned well. An example, MW-07R is a replacement of destroyed well MW-07.

- "A, B, C" will be added to the end of a well identification if the well is the result of an offset of a pilot borehole or a location that is revisited. The A, B, C notation can only by used for borings or wells that are within 5 feet of the original location. The offset distance and direction must be documented in the field notes. An example, the borehole for MW-07 could not be completed (due to refusal or other issues), MW-07A is the second attempt to complete MW-07.

5.10. Well Protection Bollards (optional)

Guard posts may be installed in high-traffic areas for additional protection. One to four guard posts would be installed around the protective casing, within the edges of the concrete pad. If used, guard posts will consist of concrete-filled steel tubes, at least 3 inches in diameter, painted with multiple coats of epoxy-based paint to prevent rust. The guard posts would extend at least two feet below ground and approximately three feet above ground.

5.11. Waste Management

Investigation derived wastes (IDW), including soil cuttings, decontamination liquids, and disposable materials (PPE, plastic sheeting, etc.) will be placed in

clearly labeled, appropriate containers in accordance with SOP 10059 *Management of Investigation Derived Waste*, or managed as otherwise specified in the site-specific Work Plan or FSP.

5.12. Documentation

Documentation of field activities will be completed in accordance with SOP *10038 Documentation of Field Sampling Activities*. In addition, record all appropriate information concerning the quantity of materials used, the type and manufacturer of the materials, the mixtures of grouts or slurries, and any pertinent notes regarding the installation of each well on the Supplemental Daily Field Report Form. A complete geologic log shall be kept during advancement of the borehole for the well and the procedures for completing geologic logs are presented in SOP ID 10015 *Standard Operating Procedure for Geologic Logging of Unconsolidated Sedimentary Materials*. Well construction details shall be recorded on the monitoring well completion form is provided in Attachment 1.

6. References

EPA. *RCRA Groundwater Monitoring Technical Enforcement Guidance Document, OSWER 9950.1*. September 1986.

EPA. *Handbook of Suggested Practices for the Design and Installation of Groundwater Monitoring Wells, 160014-891034*. March 1991.

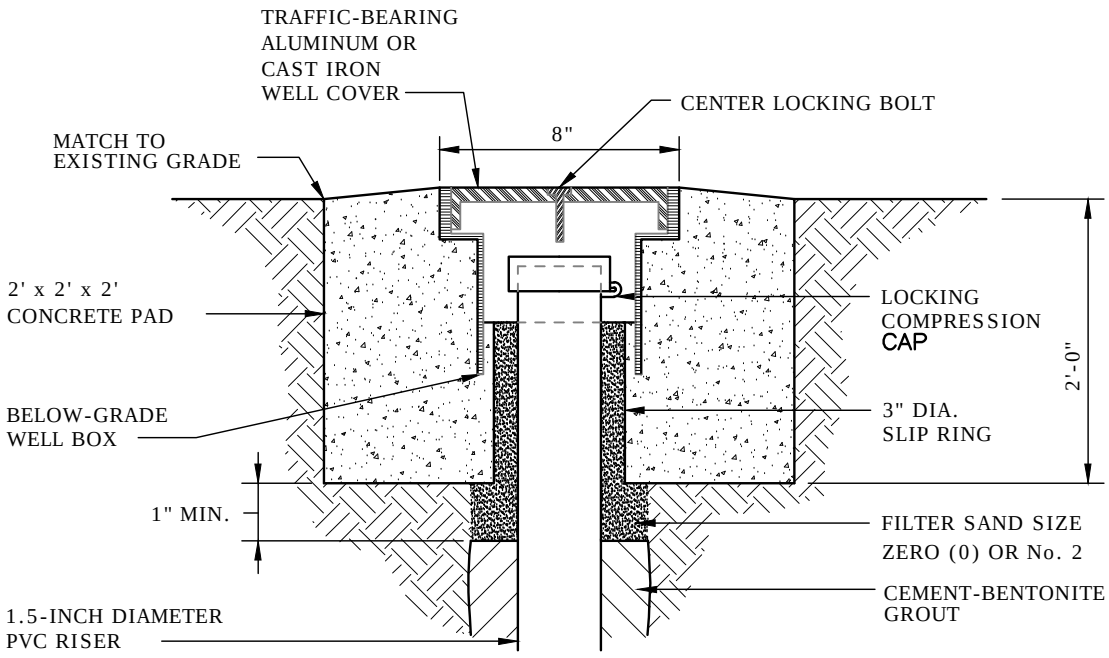
Geoprobe®. *Geoprobe® 0.5-in x 1.4 in OD and 0.75 in x 1.4 in OD Prepacked Screen Monitoring Wells, Standard Operating Procedure, Technical Bulletin No. 962000*. September 1996, revised; June 2002.

ASTM. *ASTM standard D5092, Design and Installation of Groundwater Monitoring Wells in Aquifers.* ASTM International, 2017.

END OF DOCUMENT

FIGURES

ATTACHMENT 1: Well Construction Details



FLUSH TO GRADE WELLHEAD
CONSTRUCTION DETAIL - NOT TO SCALE

REFERENCES:

EPA, "RCRA GROUNDWATER MONITORING TECHNICAL ENFORCEMENT GUIDANCE DOCUMENT", OSWER 9950.1, SEPTEMBER 1986.

EPA, "HANDBOOK OF SUGGESTED PRACTICES FOR THE DESIGN AND INSTALLATION OF GROUNDWATER MONITORING WELLS", EPA/600/4-89/034, 1989.

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LEA SOP FOR INSTALLING & DEVELOPING MONITORING WELLS & PIEZOMETERS

FLUSH MOUNT WELLHEAD DETAILS

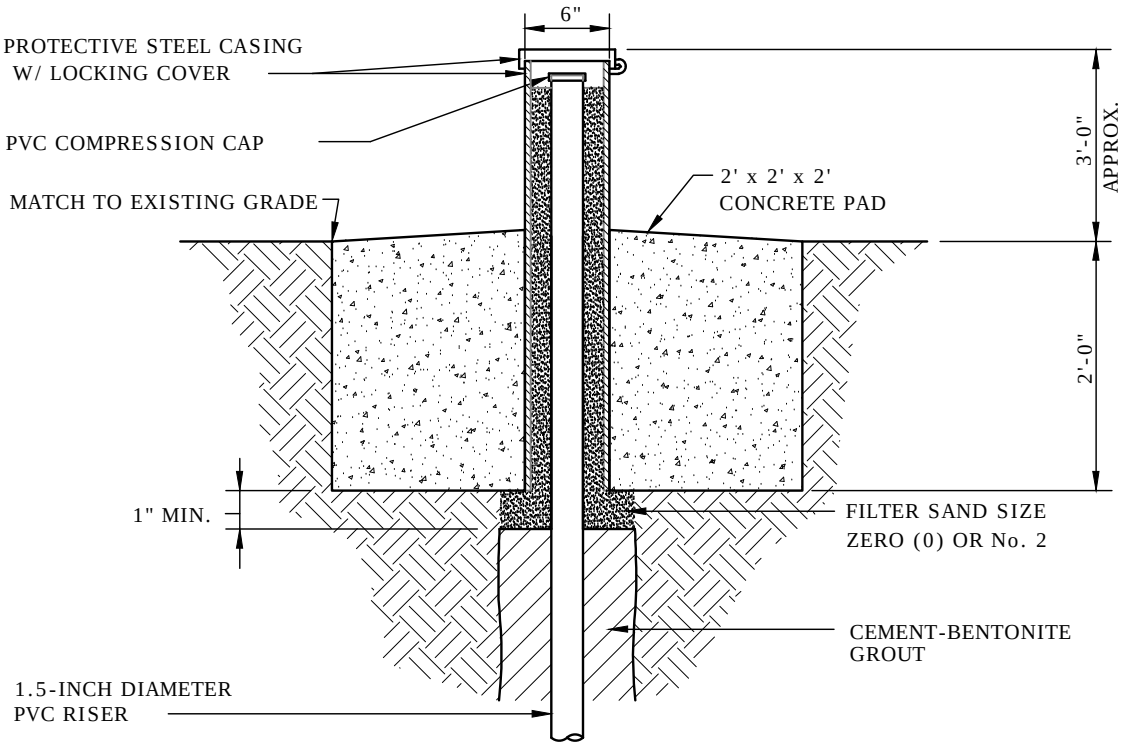
PREPARED FOR:

SCALE: NTS

COMM. NO.: 00001.01

DATE: 02/22/2018

FIGURE 1



ABOVE GRADE WELLHEAD
CONSTRUCTION DETAIL - NOT TO SCALE

REFERENCES:

EPA, "RCRA GROUNDWATER MONITORING TECHNICAL ENFORCEMENT GUIDANCE DOCUMENT", OSWER 9950.1, SEPTEMBER 1986.

EPA, "HANDBOOK OF SUGGESTED PRACTICES FOR THE DESIGN AND INSTALLATION OF GROUNDWATER MONITORING WELLS", EPA/600/4-89/034, 1989.

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STICK-UP WELLHEAD DETAIL

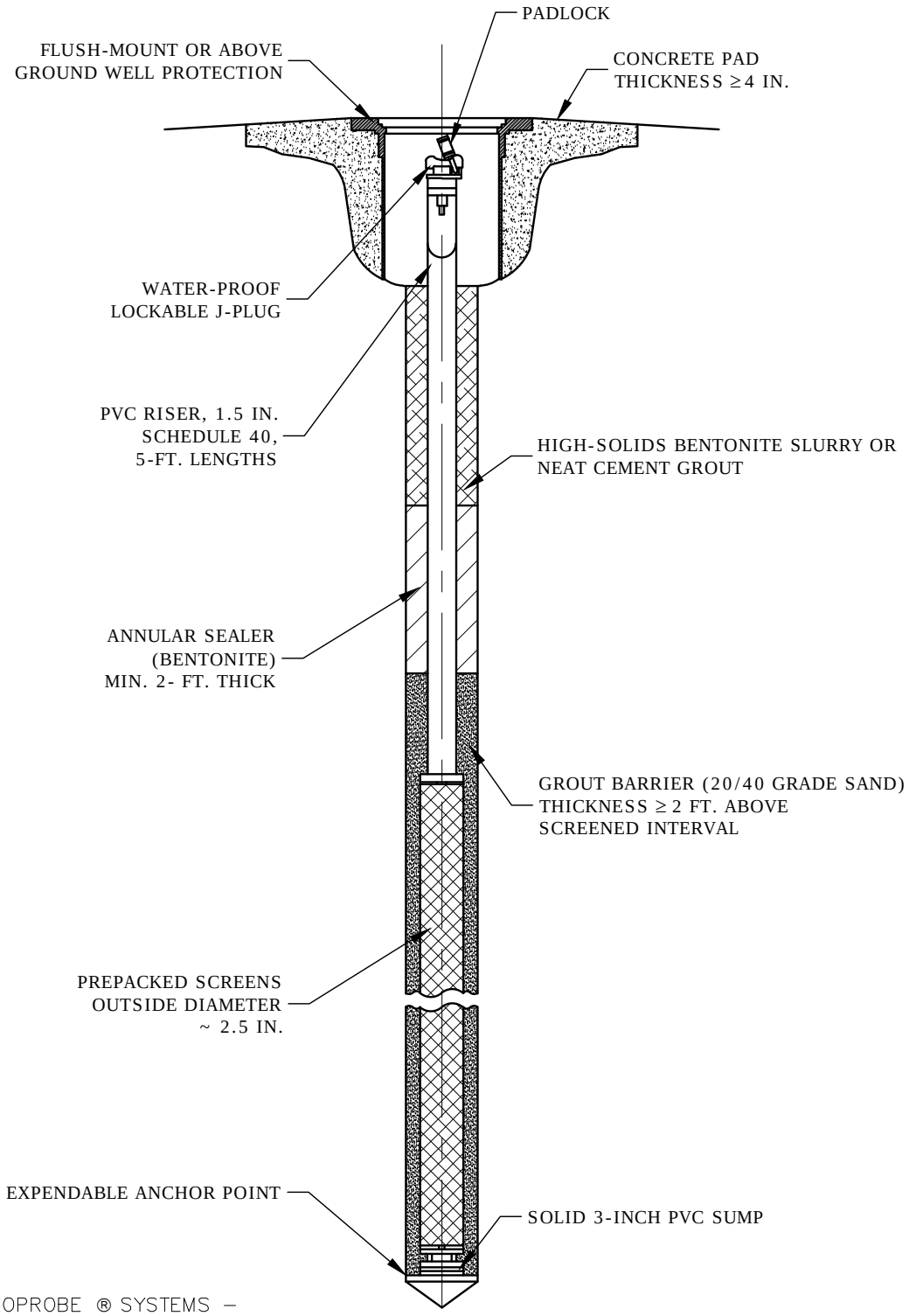
PREPARED FOR:

SCALE: NTS

COMM. NO.: 00001.01

DATE: 02/22/2018

FIGURE 2



ADAPTED FROM "GEOPROBE ® SYSTEMS – THE COMPLETE PROBING SYSTEM", TECHNICAL BULLETIN 99250, AUG. 1999, REVISED DEC. 2002.

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LEA SOP FOT INSTALLING & DEVELOPING MONITORING WELLS & PIEZOMETERS

COMPLETED PRE-PACKED SCREEN WELL

PREPARED FOR:

SCALE: NTS

COMM. NO.: 00001.01

DATE: 02/22/2018

FIGURE 3

WELL COMPLETION REPORT

Project: **Start Date** **Well ID**

LEA Comm. No.

Client **End Date**

Locatin

Drilling Contractor **Logged by**

Drilling Method **Drilling Foreman**

Sampling Method **Drill Rig**

Groundwater Observation **GPS Latitude**

Depth _____ **at** _____ **Hours** **GPS Longitude**

Protector
- Material
- Diameter
- Length
- Stickup
- Key #
- Cover Type

Ground

Top Seal
- Top
- Bottom
- Material

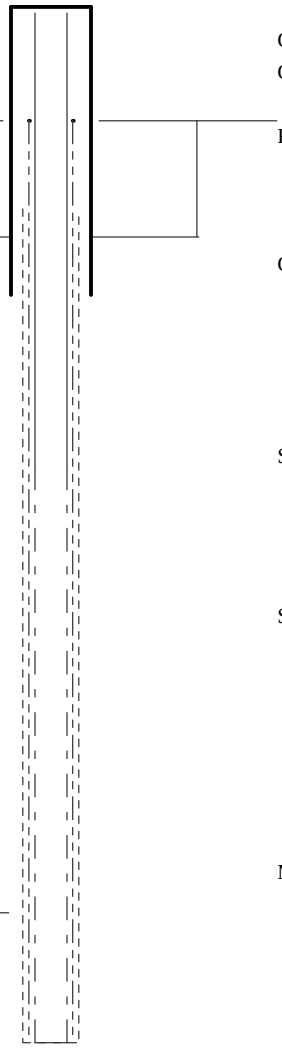
Backfill
- Top
- Bottom
- Material

Secondary Sand
- Top
- Bottom
- Size

Filter Pack
- Top
- Bottom
- Material

Reported depth to bottom of boring

Comments



Concrete Diameter

Concrete Thickness

Reference
- Stickup
- Description

Casing
- Diameter
- Material
- Length
- Stickup

Seal
- Top
- Bottom
- Material

Screen
- Top
- Bottom
- Material
- Diameter
- Length
- Slot Size

Miscellaneous Materials (Quantity Used/Item)
- Cement
- Bentonite Chips
- Bentonite Pellets
- Bentonite Powder
- Grout Weight
- Filter Pack Sand
- Capping Sand
- Well Point
- Well Plug

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Signature _____

Loureiro Engineering Associates, Inc.
Standard Operating Procedure
for
Development of Non-Water Supply Wells
and
Piezometers in Unconsolidated Deposits

SOP ID: 10007B
Date Initiated: 02/20/90
Revision No. 008: 07/18/18

Revised By: ***/s/ Jeremy Marcantonio*** ***2/20/18***
Jeremy Marcantonio **Date**
Senior Project Scientist

Reviewed By: ***/s/ Jo Ann Robertson*** ***7/18/18***
Jo Ann Robertson **Date**
Technical Associate

Approved By: ***/s/ Karen Harris*** ***7/18/18***
Karen Harris **Date**
Quality Assurance Manager

REVISION RECORD

Rev #	Date	Additions/Deletions/Modifications
Initial Issue	02/20/90	
001-004	-	No record.
005	12/31/01	Formatting and minor revisions throughout.
006	08/12/02	Added section on utility clearance.
007	11/01/12	Reference was provided to the company's updated Groundbreaking Procedure, (dated December 6, 2011). The requirement for a site-specific HASP and JHA. It was also noted that surging and pumping at the same time may not be as effective as surging and then pumping. Table 1 was incorporated describing and assessing well development equipment. Finally, Figures 1 and 2 were revised to reflect current practices for monitoring well installation.
008	07/18/18	Revisions throughout. Update to reflect new SOP format. Checked against up-to-date standards. Divided installation and development into two separate SOPs: SOP 10007A *Installation of Non-Water Supply Wells and Piezometers in Unconsolidated Deposits* and SOP 10007B Development *of Non-Water Supply Wells and Piezometers in Unconsolidated Deposits*. Sampling methodologies were updated.

Loureiro Engineering Associates, Inc.
Standard Operating Procedure
for
Development of Non-Water Supply Wells
and
Piezometers in Unconsolidated Deposits

1. Purpose and Scope

Monitoring well development may be accomplished by surging and bailing (or pumping), or over pumping. Other methods, such as air jetting, backwashing, or air-lift pumping, shall be avoided because these methods introduce fluids into the formation and may have unexpected influences on groundwater quality, if only for a short period of time. This standard operating procedure (SOP) is designed to describe the proper methods and procedures to be used to develop wells and piezometers using surging and bailing or over pumping. Applicable to wells screened in water-table aquifers and unconsolidated deposits. Throughout this SOP reference to wells is also intended to mean piezometers unless specifically indicated otherwise.

Monitoring wells will not be developed within 24 hours of installation unless specified stated otherwise in the project specific work plan (Work Plan) or Field Sampling Plan.

2. Related Standard Operating Procedures

- 10038 – Documentation and Integrity of Field Sampling Activities
- 10059 – Management of Investigation Derived Waste
- 10065 – Decontamination of Field Sampling Equipment

In addition to the above-noted SOPs, project and client-specific requirements may be applicable to individual projects and should be discussed with the Project Manager and incorporated into the project-specific plan for adherence during the execution of the project.

3. Definitions

None.

4. Equipment

The following equipment shall be used during development of non-water supply well and piezometer, as required:

- Health and safety equipment (as required by the site-specific Health and Safety Plan [HASP])
- Well Construction record
- Surge block and extensions
- Peristaltic, Whale, or Waterra pumps with matching tubing
- YSI or other meters for monitoring pH, temperature, and specific conductivity
- Turbidity meter
- Photoionizing Detector (PID) and calibration kit
- Electronic water level indicator and interface probe (accurate to 0.01 foot)
- 5-gallon bucket
- Graduated measuring cup
- Bailer
- Polyethylene plastic sheeting
- Traffic cones or barriers
- 55-gallon drum(s) and drum label(s)
- Hand tools or keys to access well
- Field documentation forms or field book
- Indelible pen
- Camera/tablet

5. Procedures

5.1. Site Preparation

5.1.1. Review and follow the health and safety procedures or requirements specified in the site-specific HASP. All personal protective equipment (PPE) shall be donned as specified in the site-specific HASP.

5.1.2. A sufficient area shall be cordoned off using traffic cones, caution tape, or barriers to restrict access to the work area.

5.1.3. Place plastic sheeting on ground surface around the well.

5.1.4. Do a visual inspection around the well and note any subsidence or raised ground around the well. Use keys or hand tools to open well.

5.2. Equipment Decontamination and Cleaning

All equipment will be decontaminated prior to starting and in between well development in accordance with SOP 10065 *Decontamination of Field Sampling Equipment* or as otherwise specified in the project-specific plan.

5.3. Well Development

Monitoring well development may be accomplished by surging and bailing (or pumping), or over pumping. Other methods, such as air jetting, backwashing, or air-lift pumping, shall be avoided because these methods introduce fluids into the formation and may have unexpected influences on groundwater quality, if only for a short period of time.

5.3.1. Immediately upon opening the well, the air in the wellhead will be screened for VOCs using a PID. The well cap shall be opened slightly and the sampling port of the PID shall be inserted into the well. The maximum reading shall be recorded on the appropriate field paperwork. The instrument shall be zeroed with ambient air prior to the measurement, and the initial and final readings shall be recorded for each well.

5.3.2. Establish a measuring point on the inner casing of well and mark with an indelible pen.

5.3.3. Collect measurements of depth to water surface and depth to bottom of well from the measuring point. Record the height of the stick up outer casing (if applicable). Use an interface probe to screen for non-aqueous phase liquids (NAPL) at the top and bottom of the well. If NAPL is identified, use bailer to collect a sample for visual description. If NAPL is observed, the project team leader shall be notified before proceeding with well development.

5.3.4. Calculate the volume of water using the following schedule and record on the appropriate field form:

Well Diameter (inches)	Conversion Factor (gallons/foot)
½	0.01
1	0.041
1 ¼	0.064
1 ½	0.091
2	0.163
4	0.654
6	1.47

5.4. Surging and Purging

In surging and purging, a well is developed by alternately surging a short section of the screen with a tight-fitting surge block and removing water from the well. Begin by lowering the surge block to the top of the screened interval and swab the well with a pumping action with a up and down stroke of 2 to 3 feet. (Begin surging at the top of the well intake to avoid having loosened material from "sand-locking" the surge block.) Do not surge the well too violently to avoid damaging the well screen or the filter pack. Remove the surge block at regular intervals and bail (or pump) the fine material from the well. Proceed with surging throughout the length of the well screen, being careful to avoid hitting the bottom of the well. Check the purge water quality using a water gage at regular intervals, as described in Section 5.6. Containerize the purge water as specified in the Work Plan.

In cases where a considerable volume of sediment may initially be drawn into the well, begin surging the well gently in the casing above the well screen. Proceed with surging and bailing to the bottom of the screened interval.

It is recommended to surge and then pump, and then repeat the cycle. However, in certain circumstances surging and pumping at the same time can be equally effective and is therefore acceptable. For example, use of an inertial pump is suitable for this process. On the other hand, in small diameter wells, a thinner diameter well casing can be used inside the larger diameter well to surge it, while at the same time the pump tubing is inserted through the inner well casing to allow pumping and removal of the grit at the same time. This technique is suitable in surging small diameter monitoring wells, however the effectiveness of surging would need to be verified by purging the well to evaluate the quality of the purged water.

If the well is screened in a low yielding formation, limit purging of the well.

Table 1 summarizes well development equipment and lists the associated advantages and disadvantages of each. The equipment is listed in the table in order of preference. However, the decision for which equipment to use is influenced by the advantages and limitations of each technique and determined by the Project Manager.

5.5. Overpumping

In overpumping, a well is developed by operating a pump in the well at a capacity which exceeds the formation's ability to supply water. The flow velocity into the well during overpumping usually exceeds the flow velocity induced during normal

sampling. This increased velocity causes movement of particles from the formation into the well.

Begin developing the well by installing a suitable pump at the bottom of the well. Alternatively, a surface-mounted pump with a suction hose may be used if the drawdown inside the well will not exceed the pump's available lift. The discharge from the pump shall be directed to approved containers. The pump (or intake hose) must be equipped with a backflow-prevention valve to prevent introducing aerated water into the aquifer.

Start the pump and discharge water at the highest practical rate. If the well runs dry, stop the pump and allow the well to recharge. Check the quality of the discharged water at regular intervals as described in the section "Completing Well Development".

5.6. Completing Well Development

During bailing or pumping, measure and record water quality parameters to gauge the degree and effectiveness of development. Field parameters including pH, temperature, specific conductivity, and turbidity shall be checked at periodic intervals (but at least every well-volume) until field parameters are stable and the purge water is clear or as specified in the project plan. The water quality parameters may be considered stable when:

- pH, temperature, and specific conductivity of consecutive measurements have relative percent differences (RPD), as defined below, of less than 10%; and
- The turbidity is 5 NTU or less (applicable only in aquifers with low percentages of fines). This may not be achievable in all situations, but the turbidity shall be less than 50 NTU and shall stabilize with an RPD of less than 10%).

  However, in no case shall the development stop before the above criteria are met, and:

  - At least 3 well volumes have been removed; or
  - The well has been surged and pumped for at least 30 minutes

The RPD between two measurements (e.g., M1 and M2) is calculated as follows:

$$RPD = \frac{|M1 - M2|}{(M1 + M2)/2} \times 100\%$$

If the well goes dry during development, development will resume when the well has recharged to 80% of the pre-development volume.

5.7. Waste Management

Investigation derived wastes (IDW), including pumping discharge decontamination liquids, and disposable materials (PPE, plastic sheeting, etc.) will be placed in clearly labeled, appropriate containers in accordance with SOP 10059 *Management of Investigation Derived Waste*, or managed as otherwise specified in the site-specific project plan.

6. Documentation

Documentation of field activities will be completed in accordance with SOP 10038 *Documentation and Integrity of Field Sampling Activites.* In addition, well development activities will be documented on the *Field Data Record Well Development Report* form.

7. References

RCRA. *Groundwater Monitoring Technical Enforcement Guidance Document, OSWER 9950.1, EPA, September* 1986.

ASTM. *Standard D5092, Design and Installation of Groundwater Monitoring Wells in Aquifers, ASTM International,* 2017.

END OF DOCUMENT

Table

TABLE 1

WELL DEVELOPMENT EQUIPMENT

Well Development Equipment	Order of Preference	Limitations	Use Scenarios
Waterra® Pump	This is the preferred method; but if not practical use methods below in the order listed.	• Well diameter must be 1" or greater. Check valves or surge blocks may need to be modified to fit into a well smaller than 2" in diameter. • High amounts of silt/sand may clog check valve. • Weight of equipment (generator, stabilizing weights for flush mount well applications). • Runs on 110V, so either a power supply or a generator is required close to the well.	Shall be used for all well development, since the flow rate and mechanical action stresses the formation and the sand pack. Shall **not** be used in wells where there is a significant amount of silt/sand which may clog the check valve.
Blue Mamba® Submersible Pump	Preferred if Waterra® is not used; if well casing is not of sufficient diameter, use method below.	• Well diameter must be 1.5" or greater • Operates off a vehicle battery, which can lose power over the course of the day, so a backup power source must be provided.	This pump can be used in a highly turbid well and must be used in combination with surge rods and a surge block.
Peristaltic Pump	Preferred if diameter of well is smaller than the outside diameter of a Waterra® check valve or a submersible pump.	• Flow rates sometimes do not stress the formation and the sand pack, even when flow rates used are at the high end of pump capability (which are the recommended rates for well development). • Water level must be within 30' of ground surface.	Shall be used along with surge rods and surge block to pump and surge at the same time. Shall not be used in wells where a submersible pump will work.
Bailers	Not preferred for development without the use of a pump, but may be used to surge and remove high accumulations of silt from wells, allowing for the use of other development equipment described above.	• Slow process. • Physically demanding. • Cannot provide steady flow rates for purging. • Need to use stainless steel bailers for weight. • Well diameters of 1" in diameter or less.	Can be used for the surge portion of well development, unless no pump is suitable.

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FIELD SAMPLING RECORD
WELL DEVELOPMENT

LEA Comm. No. Page _____ of _____
Project Date ___/___/_____
Location Time ___:___
Client

Monitoring Well Number _____ Sample Number(s) _____ _____

Initial Field Data and Measurements

Depth of Well _____ Reference Used _____
Depth to Water _____ PID/FID Reading _____
Height of Column _____ Interface Yes / No If yes, Depth _____ Lighter / Heavier

Well Casing Diameter _____ Material _____

Protector Road Box / Stickup
Ground to Reference _____
Comments _____
_____

General Condition	OK	Bad
Casing Secure		
Collar Intact		
Cover Locked		
Other (describe)		

Development Information

Purge Volume Factors
0.5" - 0.01
1" - 0.041
1.5" - 0.091
2" - 0.16
4" - 0.65
6" - 1.5

Initial Sample Observations
Clear ☐
Colored ☐
Cloudy ☐
Turbid ☐
Odor ☐
Sheen ☐

Parameter / Volumes	Gallons	Temp (C)	pH (SU)	Spec.Con.	Turbidity	Other
Initial						

Developement Method Peristaltic Pump / Bailer / Inertial Pump / Other _____

Field Decontamination? Yes / No If Yes, with what? _____
Waste Container ID _____

Additional Comments

Field Personnel _____ _____ ***Signature***
_____ _____ _____

Loureiro Engineering Associates, Inc.
Standard Operating Procedure
for
Direct Push Probing and
Sample Tooling Advancement

SOP ID: 10011
Date Initiated: 11/10/94
Revision No. 009: 09/07/18

Revised By:	***/s/ David C. Brisson***	***04/04/18***
	David C. Brisson	**Date**
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Reviewed By:	***/s/ Jo Ann Robertson***	***09/07/18***
	Jo Ann Robertson	**Date**
	Technical Associate	
`Approved By:	***/s/ Karen Harris***	***09/07/18***
	Karen Harris	**Date**
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REVISION RECORD

Rev #	Date	Additions/Deletions/Modifications
Initial Issue	11/10/94	
001-002	-	No record.
003	06/17/97	No record.
004	07/19/00	Revisions to template, including new logo. Revisions to Sections 3, 4, 5 and 6 in order to generalize sampling procedures and reference Geoprobe® Systems' catalog and specific soil sampling standard operating procedures.
005	12/31/01	Revisions made to reflect new SOP format. Addition of QA/QC section, minor changes throughout.
006	02/11/08	Added Appendix A: Macro-Core Soil Sampling; Revisions to Section 4.13.
007	08/23/10	Added supplemental information regarding grout mixture preparation in the section on "Boring Abandonment."
008	07/13/18	Removed sections of text regarding: tooling, health and safety, decontamination. Added technical bulletin for MC5 sampler.
009	09/07/18	Added nomenclature section.

Loureiro Engineering Associates, Inc.
Standard Operating Procedure
for
Direct Push Probing and Sampling Tooling Advancement

1. Purpose and Scope

The objective of this standard operating procedure (SOP) is to collect discrete soil samples at depth using Geoprobe® or other direct push probing and sampling methodologies and to recover the samples for visual inspection and/or analysis. Procedures for soil sampling for analysis are included in SOP 10006 *Soil Sampling.* Throughout this SOP, references to Geoprobe® are also intended to include other direct push technologies unless specifically stated otherwise.

2. Related Standard Operating Procedures

- 10005 – Quality Assurance/Quality Control Measures for Field Sampling Activities
- 10006 – Soil Sampling
- 10015 – Geologic Logging of Unconsolidated Sedimentary Deposits
- 10038 – Documentation and Integrity of Field Sampling Activities
- 10059 – Management of Investigation-Derived Waste
- 10065 – Decontamination of Field Sampling Equipment

In addition to the above-noted SOPs, project and client-specific requirements may be applicable to individual projects and should be discussed with the Project Manager and incorporated into the project-specific work plan or Field Sampling Plan (WP/FSP) for adherence during the execution of the project.

3. Definitions

Geoprobe®[1]:or similar direct push technology: A vehicle-mounted, hydraulically-powered, soil probing machine that utilizes static force and percussion to advance small diameter sampling tools into the subsurface for collecting soil core, soil gas, or groundwater samples.

- Sampler: A piston type soil sampler capable of recovering a discrete sample in the form of a core contained inside a removable liner.

- Liner: A removable/replaceable, thin-walled tube inserted inside the sampler body for the purpose of containing and storing soil samples. Clear plastic (either Polyethylene Terephthalate Glycol [PETG] or cellulose acetate butyrate) are utilized as liner materials.

[1] Geoprobe® is a registered trademark of Kejr Engineering, Inc., Salina, Kansas.

4. Equipment

The equipment required to recover soil core samples using the Geoprobe® samplers and driving system can be found in the Geoprobe® Systems catalog for tools and equipment, as referenced in Section 6. Some things to note when selecting equipment:

- Health and safety equipment (as required by the site-specific Health and Safety Plan [HASP])
- Geoprobe® or similar direct push technology
- Sample liners for the Geoprobe® samplers are available in four different materials. Liner materials should be selected based on sampling purpose, analytical parameters, and data quality objectives
- Traffic cones, caution tape, or barrier

5. Procedure

5.1. Utilities Clearance

Underground utilities clearance will be conducted in accordance with the LEA ground breaking procedure.

5.2. Site Preparation

5.2.1. Review and follow the health and safety procedures or requirements specified in the site-specific HASP. All necessary personal protective equipment (PPE) shall be donned as specified in the site-specific HASP.

5.2.2. A sufficient area shall be cordoned off using traffic cones, caution tape or barriers to restrict access to the work area.

5.3. Equipment Decontamination and Cleaning

5.3.1. All downhole drilling equipment will be decontaminated in accordance with SOP 10065 *Decontamination of Sampling Equipment*. Prior to conducting a boring, the LEA representative will ensure that all necessary equipment is clean and decontaminated, including the rig, all augers and probing equipment, samplers, brushes, and any other tools or equipment. Decontamination procedures may vary slightly from site to site. Refer to the site-specific WP/FSP for decontamination procedure alterations.

5.4. General Sampler Assembly

5.4.1. The sampler is connected to the leading end of a Geoprobe® probe rod and driven into the subsurface using a Geoprobe® drilling apparatus. Additional probe rods are connected in succession to advance the sampler to depth. The sampler remains sealed (closed) by a piston tip to prevent cross contamination from above as it is being driven. The piston is held in place by internal rods. The first four-foot interval does not require the piston tip assembly. In addition, if the borehole remains open, the piston tip assembly may not be required for deeper intervals. If there is evidence that the borehole is collapsing, the piston tip will be utilized.

5.4.2. When the sampler tip has reached the top of the desired sampling interval, the internal rods are removed.

5.4.3. After the internal rods have been removed, the tool string is advanced an additional 24 to 48 inches (depending on the soil sampling system in use). The piston is displaced inside the sampler body by the soil as the sample is cut. To recover the sample, the sampler is recovered from the hole and the liner containing the soil sample is removed.

5.4.4. Refer to the Geoprobe® System standard operating procedures for operation of various soil sampling systems (e.g., MC5 Soil Sampling System, Macro Core Piston Rod Soil Sampling System, DT21 Dual Tube Soil Sampling System, Large Bore Soil Sampling System).

5.5. Concrete Coring

Should the borehole be located on concrete, the Geoprobe® can be used to core through the concrete to gain access to the underlying soil. A carbide-tipped drill bit and Geoprobe® drill steel will be attached to the drill assembly and utilized to core the concrete. For concrete in excess of 16 inches, other methods (i.e., a core saw) should be utilized to penetrate the concrete.

5.5.1. If excessive resistance is encountered while attempting to lift the sampler and probe rod out of the hole using the foot control, unscrew the drive head from the sampler and remove it with the probe rod, the piston rod, and the piston tip. Replace the drive head onto the sampler and attach a pull cap to it. Lower the probe shell and close the hammer latch over the pull cap and pull the sampler the remaining distance out of the hole with the probe machine foot firmly on the ground.

5.6. Sample Recovery

Unscrew the cutting shoe using the cutting shoe wrench, if necessary. Pull the cutting shoe out with the liner attached. If the liner doesn't slide out readily with the cutting shoe, take off the drive head and push down on the sidewall of the liner. The liner and sample should slide out easily.

5.7. Core Liner Capping

The ends of the liners can be capped off using the vinyl end cap for further storage or transportation. A black end cap should be used at the bottom (down end) of the sample core and a red end cap at the top (up end) of the core. The soil boring identifier and depth of sample should be marked at the top of the core (on the red end cap).

5.8. Sample Removal

5.8.1. To facilitate sample removal, each vinyl end cap can be slid off or, if there is resistance, they can be slit using a utility knife with a carpet blade. To cut vinyl end cap, slide blade under edge of cap at shallow angle and rotate the blade until cutting edge begins to cut the vinyl cap, and then draw the knife slowly toward the end of the cap. As the friction is reduced the end cap may move with the knife and become free of the sample liner.

5.8.2. Clear plastic and Teflon® liners can be slit open easily with a utility knife for the samples to be analyzed or placed in appropriate containers.

5.8.3. The procedures for collection of soil samples for chemical analysis are described in SOP 10006 *Soil Sampling*.

5.9. Refusal

Refusal is defined as failure to penetrate the subsurface materials to any greater depth using the maximum reasonable pressure limits of the Geoprobe® machine. The term “refusal” should be used on the boring log to describe the conditions at the interval in which the tooling would no longer advance.

The term "bedrock" will not be used in a boring log or other description of subsurface materials that have been collected using the Geoprobe® machine, since a confirmatory core cannot be collected.

5.10. Boring Abandonment

5.10.1. If the boring is not to be used for other purposes (i.e., monitoring well, soil vapor probe, soil vapor extraction well, etc.) it shall be abandoned.

5.10.2. Excess cuttings shall be containerized, labeled and the analytical data of the contents reviewed/profiled before disposal.

5.10.3. The boring shall be filled and sealed with in accordance with the site-specific WP/FSP.

5.10.4. In paved areas, the upper three feet of the borehole shall be filled, from 3 feet below ground surface up to two inches below the existing grade with sand, to allow for repairing of the pavement.

5.10.5. The surface shall be repaired to match existing conditions.

5.11. Nomenclature

The boring identification guidance will be provided in the WP/FSP. The following is guidance for identify offsets or step out borings.

- "A, B, C" will be added to the end of a boring identification if the boring is the result of an offset from a pilot borehole or a location that is revisited. The A, B, C notation will only by used for borings that are within 5 ft of the original location. The offset distance and direction must be documented in the field notes. An example, the borehole for SB-07 could not be completed (due to refusal or other issues), SB-07A is the second attempt to complete SB-07. Borings greater than 5 feet from the original location will be assigned a new boring ID.

5.12. Waste Management

Investigation-derived wastes (IDW), including soil cuttings, decontamination liquids, and disposable materials (PPE, plastic sheeting, etc.), will be placed in clearly labeled, appropriate containers in accordance with SOP 10059 *Management of Investigation Derived Waste*, or managed as otherwise specified in the site-specific WP/FSP.

5.13. Documentation

Documentation of field activities will be completed in accordance with SOP 10038 *Documentation of Field Sampling Activities*.

6. References

Geoprobe® Systems. *1998-1999, 2017 Tools and Equipment Catalog*. 1997.

Geoprobe® Systems. *Geoprobe® DT22 Dual Tube Soil Sampling System, Continuous Core Soil Sampler Standard Operating Procedure*, Technical Bulletin No. 982100. 9/98 revised 01/2013.

Geoprobe® Systems. *Geoprobe® Large Bore Soil Sampler, Discrete Interval Soil Sampler Standard Operating Procedure*, Technical Bulletin No. 93-660. Prepared 09/96, revised 04/98, 01/2011.

Geoprobe® Systems. *Geoprobe® Macro Core MC5 1.25 inch Light-Weight Center Rod Soil Sampling System, Standard Operating Procedure*, Technical Bulletin No. MK3139. 2011.

END OF DOCUMENT

Loureiro Engineering Associates, Inc.
Standard Operating Procedure
for
Geologic Logging
of
Unconsolidated Sedimentary Materials

SOP ID: 10015
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Revised By:	***/s/ Sarah Burkhalter-Sweeney***	***09/10/18***
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Reviewed By:	**/s/ *Jo Ann Robertson***	***09/10/18***
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Approved By:	**/s/ *Karen Harris***	***09/12/18***
	Karen Harris	**Date**
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REVISION RECORD

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Initial Issue	12/27/94	
001	11/20/96	No record.
002	01/15/02	Formatting and minor revisions throughout.
003	07/17/18	Updating, formatting, and minor revisions throughout.
004	09/12/18	Revised Section 5.1 to include photographing soil samples and attached boring log form

Loureiro Engineering Associates, Inc.
Standard Operating Procedure
for
Geologic Logging of Unconsolidated Sedimentary Materials

1. Purpose and Scope

This document presents the methods and procedures used to describe unconsolidated sedimentary materials for geological purposes in a uniform and consistent manner. It includes procedures for properly recording the observations by providing guidelines for completing boring logs and submitting those logs for computer entry. This Standard Operating Procedure (SOP) refers only to geologic logging of soils and sediments (including artificial fill and other man-made deposits) and specifically is not intended to describe logging of soils or sediments for geotechnical or other engineering purposes. Although the SOP presents a system for describing sediments, it is not intended to be a definitive reference for classifying sedimentary materials, nor is it intended to replace experience or training. Individuals using this SOP should be trained and competent in field methodologies and geologic logging prior to commencing field activities.

2. Related Standard Operating Procedures

- 10003 – Hand Auger Borings
- 10006 – Soil Sampling
- 10008 – Hollow Stem Auger Soil Borings
- 10011 – Direct Push Probing and Sampling Tool Advancement
- 10038 – Documentation and Integrity of Field Sampling Activities
- 10057 – Collecting and Preserving Soil and Sediment Samples for Laboratory Determination of Volatile Organic Compounds
- 10059 – Management of Investigation Derived Waste
- 10065 – Decontamination of Field Sampling Equipment

In addition to the above-noted SOPs, project and client-specific requirements may be applicable to individual projects and should be discussed with the Project Manager and incorporated into the project-specific work plan (work plan) for adherence during the execution of the project.

3. Definitions

Scale: A linear scale, also called a bar scale, scale bar, graphic scale, or graphical scale, is a means of visually showing scale in photograph.

4. Equipment

The following equipment and supplies shall be used during geologic logging of soil/sediment samples, as required:

- Tape measure or scale
- Hand lens
- Color chart
- Grain-size comparator
- Field forms
- Clipboard
- Camera (if dictated by project)
- Scale or measuring tape

5. Procedures

5.1. Sample Collection

Sampling should occur prior to description of soils or sediments to preserve VOCs (if applicable), but also to prevent cross contamination. VOCs will be sampled in accordance with SOP 10057 *Collecting and Preserving Soil and Sediment Samples for Laboratory Determination of Volatile Organic Compounds* and other samples in accordance with SOP 10006 *Soil Sampling*. Photograph each soil sample with scale. Photography may be restricted based on site-specific requirements and should be reviewed prior to field activities.

5.2. Descriptions of Unconsolidated Sedimentary Materials

5.2.1. General Sediment Description Guidelines

For the purposes of geologically logging unconsolidated soils and sedimentary materials, a Modified Burmister method of description and classification will be used. The Modified Burmister Sediment Classification System (or simply, Burmister System) is intended as a rapid field method for identifying and classifying sediments. The system is based upon visual identification of the generalized grain-size distribution and description of the physical characteristics of the sample.

A Burmister System description is comprised of three parts: a color descriptor; a grain-size descriptor; and modifier(s). The color descriptor indicates the overall color or colors of the wet sample. The descriptor consists of a color name or names and (if possible) the color code from a standard color reference (for example, a Munsell Color Chart). The grain-size description indicates the predominant grain size in the sample, as well as the relative percentages of other grain sizes present.

Modifiers are used to further describe the geologic character of the sample. Modifiers may include descriptions of moisture content, sorting, sphericity, angularity, sedimentary structures, or other pertinent information.

5.2.2. Color Description

The color of the wet sediment should be determined with reference to a standard color comparator (for example, a Munsell Color Chart) for rocks or sediment. The included color descriptor should contain the color name and, when a color comparator is used, the appropriate hue-chroma value code, for example "Reddish brown (5YR 4/4)". The color of a sample should be gauged when the sample is wet, or it should be noted otherwise.

5.2.3. Predominant Grain-Size Description

The first step in describing a sediment sample is visually estimating the size range and percentage of the various grain sizes in the sample. Reference should be made to standard geologic comparators for assessment of the grain size(s).

The primary grain-size descriptor indicates the predominant grain size, as judged visually, of the sample. The descriptor is always capitalized and underlined. Possible descriptors include: CLAY, SILT, SAND, and GRAVEL (GRANULES, PEBBLES, COBBLES, and BOULDERS). These correspond to the standard Wentworth size-classification scheme used for describing sediments for geologic purposes. Size classifications for CLAY through GRAVEL are presented in Figure 1 (COBBLES and BOULDERS as defined in the Wentworth classification scheme, are not depicted and will be defined as necessary in the Work Plans). The descriptor should also include an indication of the relative size range of the sample within the predominant grain size (for example, "fine-to-medium sand", "coarse sand", etc.). Although the Wentworth size classification scheme includes divisions of the silt category, this is applicable only to sediment samples analyzed by pipette or hydrometer and cannot be

distinguished in the field. The processes to perform pipette or hydrometer analysis are not covered in this SOP and, if required, will be provided in the work plan.

The presence of other grain sizes, in addition to the predominant material is also included in the grain-size descriptor. Appropriate grain sizes are the same as for the predominant grain size of the material (clay, silt, etc.), however only the initial letter of the word is capitalized. The description should also include an indication of the relative amount of the minor components. Appropriate indicators for the relative percentages present are provided in Table 1.

It is generally not considered possible to visually distinguish between clay and silt. Estimation of the silt/clay content of a sample should be based upon the plastic properties of the sample. The plastic properties of the sample may be estimated by taking an approximately 1 cubic centimeter ball of the sediment and attempting to roll a thread of the material between the palms of the hand. The minimum size of the thread which may be rolled may be compared to the values presented in Table 2 and the plasticity estimated. A comparison of the minimum thread diameter which may be formed with the information presented in Table 2 provides an approximate silt/clay content estimate for sand-silt-clay sediments and composite clay sediments.

5.2.4. Modifiers

Various modifiers may be added to the basic sediment description to further describe the geologic character of the sample.

For sand or coarser-sized material, the relative degree of sorting, the sphericity, and angularity should also be recorded. Sorting may be visually estimated. Sphericity and angularity, however, should be made with reference to an accepted comparator. A chart illustrating various degrees of sorting, sphericity, and angularity is attached as Figure 1.

The mineralogy of the sample should also be recorded if possible. Reference should be made to the relative percentages, grain size(s), and sphericity of the mineral particles (especially where it differs significantly from that of the predominant grain-size material).

Other information which should be recorded for each sample includes an estimate of the density and cohesiveness of the sample (made from blow counts where applicable, or other specific instrumentation where

appropriate), the relative moisture content of the sample, visible sedimentary structures, and any odors or staining noticeable during logging. Tables 2 and 3 present appropriate terms for describing the plasticity, density, and cohesiveness of sediment samples.

Especially important is an indication that a specific portion of the material may represent "sluff" or material collapsed from the borehole walls.

5.3. Written Sediment Descriptions

The written sediment description may be made as either an unabbreviated or an abbreviated description. Both methods should relate the same information, however the abbreviated description is better suited for field use.

In an unabbreviated description, all of the words of the description should be written out in their entirety. The descriptor should include pertinent information regarding the sample's size gradation (smallest to largest), consistency, color, and relative grain size, as described previously. The color descriptor should precede the primary sediment component name, while additional details such as the plasticity, mineralogy, visible sedimentary structures, etc., should follow the sediment component name.

An example of an unabbreviated description is:

Red-brown (5YR 4/4), fine to coarse SAND, little fine Gravel, little Silt, moist, moderately well sorted, low sphericity, Gravel waterworn, Sand subangular, micaceous.

Since the Burmister system is intended to provide a means for describing uniform sediments, three "special" cases should be addressed.

First, the Burmister system is intended only to describe the sediment. Where a genetic classification of the material is significant, it should be added as a separate statement at the end of the description. For example:

Olive gray (5Y 4/2), coarse to fine SAND, some fine Gravel, little Silt, moist, poorly sorted, sub-rounded to angular, dense. TILL.

A genetic classification should only be used when the origin of the material is very clear and not simply a field interpretation of possible depositional environment.

Second, in the case where the sediment sample is heterogeneous (for example, a varved silt and clay), each component should be described individually, and

reference should be made to the relative percentages of each component and to the interlayering. For example:

> **Reddish-brown (5YR 3/4), CLAY and SILT, alternately layered, soft, medium to high overall plasticity. Layers: CLAY layers, 3/8" to 5/8" thick, comprise 60% of sample. SILT layers, 1/8" to 3/8" thick, comprise 40% of sample. VARVED CLAY and SILT.**

Third, when one material grades uniformly into a distinct sediment type, the individual components should be described separately and the gradation noted. For example:

> **Reddish-brown (5YR 3/4), CLAY, medium overall plasticity, grading into soft, reddish-brown (5YR 4/4), SILT, trace Clay, soft, low overall plasticity.**

In the abbreviated sediment descriptions, the sample information is presented in a manner analogous to that for the unabbreviated description substituting standard abbreviations for specific portions of the text. Abbreviations for the identifying terms in the Burmister system are presented in Tables 1, 2, and 3. Mineralogic and geologic abbreviations may be found in standard geologic and mineralogic texts and field manuals. Except for the use of abbreviations, the abbreviated description is completely analogous to the unabbreviated description.

For the sake of consistency in describing unconsolidated sedimentary materials, the description should follow the order and general definitions presented in Table 4.

6. Documentation

Documentation of field activities will be completed in accordance with Loureiro SOP 10038 *Documentation and Integrity of Field Sampling Activities.* Additional documentation will include the following:

6.1. Recording Descriptions

Geologic Boring Logs

Attached to this SOP is a copy of LEA standard geologic boring log form. This log should be completed for each boring that is completed. The heading information is self-explanatory. The body of the log contains space for information for each sampled interval in the boring. The following information should be recorded:

Depth Interval	The upper and lower depths from which the sample was collected.
Sample No.	The sample number, as obtained from LEA Data Management, assigned to this sample.
Recovery	The length of the recovered sample and the length of the sampler (in consistent units). The percent recovery will be calculated by the LEA Data Management program.
Blows/6"	The number of blow counts per 6" interval for the sample. Alternately, the downhole pressure or other pertinent information regarding the required drilling or sampling force.
Sample Description	The sample description using the guidelines and order presented in Section 5.0 and Table 4.
PID/FID	The headspace reading from a photoionization detector (PID) or flame ionization detector (FID) in ppm (if required).

The comments section of the form should be used to record general observations regarding drilling conditions, backfilling of the borehole, or other pertinent information regarding drilling the borehole.

6.2. The following general information shall be recorded in the field log book and/or on the appropriate field forms:

- Name of recorder
- Identification of borings
- Collection method
- Date and time of collection
- Types of sample containers used, sample identification numbers and QA/QC sample identification
- Preservative(s) used
- Parameters requested for analysis
- Field analysis method(s)
- Field observations on sampling event
- Name of collector
- Climatic conditions, including air temperature
- Investigation derived waste (IDW)
- Field Sketch of sample location and color/type of flagging (if used)

7. References

None.

END OF DOCUMENT

Table 1
Modified Burmister System Descriptors

Fractions		Proportion Descriptors		
(+)	Major Fraction	Quantity	Descriptor	Abbreviation
(-)	Minor Fraction	35% - 50%	and	a
e.g., a medium to coarse SAND which is predominantly medium grained would be written as: m(+) - c SAND		20% - 35%	some	s
		10% - 20%	little	l
		1% - 10%	trace	t
Modifiers: (+) Upper a of the range (-) Lower a of the range				

Table 2
Plasticity of Sediment Samples

Material	Symbol	Feel	Ease of Rolling Thread	Minimum Thread Diameter	Plasticity Index	Plasticity
Clayey SILT	CyM	Rough	Difficult	1/4"	1 to 5	Slight (Sl)
SILT & CLAY	M & C	Rough	Less Difficult	1/8"	5 to 10	Low (L)
CLAY & SILT	C & M	Smooth, dull	Readily	1/16"	10 to 20	Medium (M)
Silty CLAY	MyC	Shiny	Easy	1/32"	20 to 40	High (H)
CLAY	C	Waxy, very shiny	Easy	1/64"	40 +	Very High (VH)

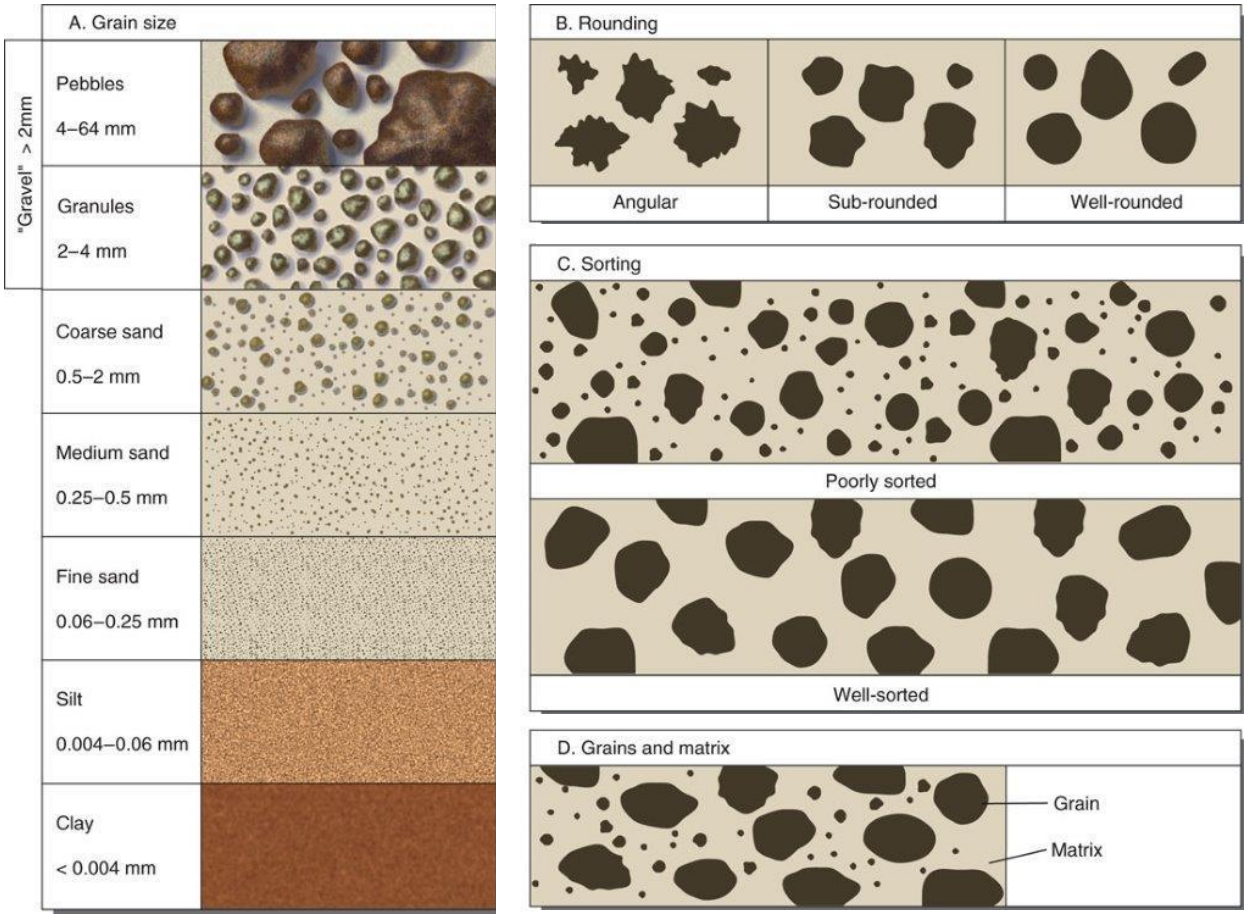
Table 3
Density and Cohesiveness of Sediment Samples

Density of Cohesionless Soils		Consistency of Cohesive Soils	
Blow Counts	Relative Density	Blow Counts	Consistency
0 to 4	Very Loose	0 to 2	Very Soft
5 to 9	Loose	2 to 4	Soft
10 to 29	Medium Dense	4 to 8	Medium
30 to 49	Dense	8 to 15	Stiff
50 to 79	Very Dense	15 to 30	Very Stiff
80 or more	Extremely Dense	30 or more	Hard

Table 4
Description of Sediment Properties

Sediment Parameter	Properties
Color	The color of the sample should be described for the wet sediments. If possible the color should be referenced to a standard color chart such as a Munsell7 Color Chart.
Primary Grain Size	Primary grain size refers to the size of the predominant sedimentary size class within the material (as judged visually). The grain size divisions should conform to the standard Wentworth Scale divisions, as shown in Figure 1.
Secondary Grain Size(s)	Secondary grain size(s) refer to material which, as a grain-size group, comprises less than the majority of the sediment. Aside from stating the size classification, the relative percentage of the material must be stated. The grain size divisions should conform to the standard Wentworth Scale divisions as shown in Figure 1. To describe the approximate percentage of the secondary grain size(s) present, qualifiers shown in Table 1 should be used.
Moisture Content	The moisture content of the sample should be described as dry, slightly moist, moist, or wet. Gradation from one state to another should be recorded as, for example, moist to wet, or moisty wet.
Sorting	The relative degree of sorting of the sediment should be indicated as poor, moderate, good, or very good. The degree of sorting is a function of the number of grain size classes present in the sample; the greater the number of classes present the poorer the sorting. In addition, for samples composed only of sand, the relative degree of sorting is a function of the number of sand-size subclasses present.
Sphericity	Sphericity is a measure of how well the individual grains, on average, approximate a sphere. The average sphericity of the sand and larger size fractions should be described as low, moderate or high. A chart illustrating various degrees of sphericity is presented in Figure 1.
Angularity	Angularity, or roundness, refers to the sharpness of the edges and corners of a grain (or the majority of the grains). Five degrees of angularity are shown in Figure 1: Angular (sharp edges and corners, little evidence of wear); Subangular (edges and corners rounded, faces untouched by wear); Subrounded (edges and corners rounded to smooth curves, original faces show some areas of wear); Rounded (edges and corners rounded to broad curves, original faces worn away); and, Well Rounded (no original edges, faces, or curves, no flat surfaces remain on grains).
Sedimentary Structures	Sedimentary structures are such things as varved layers, distinct bedding, or stratification.
Density -or- Cohesiveness	The density of cohesion of a sample (for the purposes of this application) refer to the sample's resistance to penetration by a sampling device. Density is used in reference to sediments primarily silt-size and coarser while cohesiveness is used in reference to primarily clay-sized sediments. Density or cohesiveness can be assessed from the number of blows from "standard" split-spoon sampling (i.e., 140# hammer, 30" fall, 2" X 2" (O.D., 1 3/8" I.D.)) split-spoon samplers according to the scale in Table 2.

Figure 1



ATTACHMENT 1
Field Boring Log

Loureiro
Engineering • Construction • EH&S • Energy • Waste

FIELD BORING LOG

BORING ID: _____

LEA Comm. No. 0000100.001		Elevation _____	Page _____ of _____
Project		Datum _____	Date ___/___/_____
Location	LEA	GPS Latitude/Easting _____	
Client		GPS Longitude/Northing _____	
Drilling Method _____		Drilling Contractor _____	
Sampling Method _____		Drill Foreman _____	
Groundwater Depth _____ at _____		Drill Rig _____	

Elevation/ Depth	Sample Information						Description of Recovered Material
	Sample Number(s)	Recovery (% or n/n)	Blows/6" / Downforce	Time	PID/FID (ppm)	Mass	(Color, primary grain size and amount, other grain size(s) and amounts, density, moisture, coherence, structure, sorting, other characteristics)

Comments

Survey accuracy

Waste Container Trip Blank ID(s) Cooler ID

Field Personnel _____ _____ ***Signature***

_____ _____ _____

Loureiro Engineering Associates, Inc.
Standard Operating Procedure
for
Processing Performance Evaluation Samples

SOP ID: 10030
Date Initiated: 04/01/98
Revision No. 003: 07/27/18

Revised By: ***/s/ Dan J. Hagen*** ***07/19/18***
Dan J. Hagen **Date**
Project Scientist

Reviewed By: ***/s/ Karen A. Goldenberg*** ***07/27/18***
Karen A. Goldenberg **Date**
Senior Technical Associate

Reviewed By: ***/s/ Brian A. Cutler*** ***07/27/18***
Brian A. Cutler **Date**
President

□ev □	Date	□dditions/Deletions/Modi□ications
□nitial □ssue	0□/0□/□□	
00□	0□/□□/0□	□evisions throughout□□□dated to re□lect ne□ S□□□ormat□
00□	0□/0□/0□	□hanged S□□title □rom □□rdering□to □□rocessing□□
00□	0□/□□/□□	□evisions throughout□ □evised to: □□□include additional de□initions and ty□es o□cooler tem□erature indicators, □□□u□date and clari□y □E ordering instructions, □□□allo□ □or sam□le □rocessing at a location other than the □E□ o□□ice, and □□□re□lect ne□ S□□□ormat and language□

Loureiro Engineering Associates, Inc.
Standard Operating Procedure
for
Processing Performance Evaluation Samples

1. Purpose and Scope

This document discusses procedures for obtaining and submitting full volume liquid performance evaluation (PE) samples to analytical laboratories that are used by Loureiro Engineering Associates, Inc. (LEA). Please note that these samples may also be referred to as proficiency testing (PT) samples. The procedures outlined in this document are for the purpose of establishing systematic procedures for obtaining, storing, handling, and submitting PE samples. This standard operating procedure (SOP) is intended to serve as a reference for any LEA employee submitting PE samples to an analytical laboratory. Quality assurance/quality control (QA/QC) procedures as they pertain to PE samples have also been incorporated into this SOP.

Not all projects or media sampled require the use of PE samples. The decision whether to use PE samples is project specific, dictated by data quality objectives (DQOs) and agency requirements. Refer to project specific documents, the site specific QAP, Field Sampling Plan, or Quality Assurance Project Plan (QAPP) for details regarding the need for PE samples as well as the media, constituents, concentrations, and frequency at which PE samples are required.

The procedures outlined in this document are standard (i.e., typically applicable) operating procedures which may be varied or changed as required, dependent upon site conditions, equipment limitation, or limitations imposed by the procedure. Any variations from this procedure should be documented in the Daily Field Report Supplemental Sheet. The procedures outlined in this document will result in a single- or double-blind full volume liquid or solid PE sample. If a site specific or air media PE sample is required, project specific modifications to this procedure will be required.

2. Related Standard Operating Procedures

- 1005 – QA/QC Measures for Field Sampling Activities
- 1038 – Documentation and Integrity of Field Sampling Activities
- 1067 – Handling, Packaging, and Shipping of Analytical Samples

3. Definitions

- □E sam□le: □ sam□le, the com□osition o□ □hich is □no□n to the auditor and un□no□n to the laboratory or analyst□ □E sam□les are □ro□ided to assess the ca□ability o□the laboratory or analyst to □roduce analytical results □ithin acce□table criteria□ □E sam□les can □all into three categories: □□□re□uali□ication □conducted □rior to a laboratory beginning □ro□ect □or□□ to establish initial □ro□iciency□ □□□eriodic □e□g□, □uarterly, monthly, or e□isodic□, to establish ongoing laboratory □ro□iciency□and □□batch□s□eci□ic, □hich is conducted simultaneously □ith analysis o□a sam□le batch□ □E sam□les may also be re□erred to as □□ sam□les□

- □lind Sam□le: □ sam□le submitted □or analysis □ith a com□osition and/or identity □no□n to the auditor but un□no□n to the laboratory or analyst□ Sam□les may be either single□blind □the analytes and concentrations in the sam□le are un□no□n□or double□blind □the analytes, concentrations, and identity o□the sam□le are un□no□n□□ □re□uali□ication sam□les are ty□ically single□blind□

- □m□ulated □E sam□le: □ sam□le that is received □rom the □E vendor that re□uires dilution be□ore it can be □rocessed by the laboratory as an analytical sam□le□ □hese ty□es o□□E sam□les can only be single blind□

- □ull □olume □E sam□le: □ □E sam□le that is received by the laboratory ready to be treated as an analytical sam□le□ □t does not re□uire dilution and there□ore can be single or double blind□

- Site□S□eci□ic □E sam□le: □ □E sam□le created using a □ell□characteri□ed contaminated matri□ and treated as an analytical sam□le by the laboratory to test its ca□abilities□

- □ooler tem□erature indicator: □ device that monitors the tem□erature inside the sam□le cooler□ □em□erature blan□s □ill indicate the tem□erature o□the sam□les □hen the cooler is o□ened□ □ther devices, such as a recording thermometer or tem□erature stri□, □ill noti□y the reci□ient □hen the sam□les have e□ceeded the ma□imum tem□erature□

- □em□erature□controlled container: □ tem□erature□controlled container may be a re□rigerator or iced cooler□ □he container must be □e□t at a tem□erature o□□□□ □ □□□

4. Equipment

- □aboratory glass□are
- □ooler □ith identi□iable cooler □D
- □hain o□□custody □orm

- □hermometer
- Dedicated sam□le labels

5. Procedure

□□□□ De□ine Evaluation □e□uirements

□□□□□□ De□ine sam□ling ob□ectives □ith □ro□ect Manager□ □□the □E sam□le is □eriodic or batch s□eci□ic, coordinate the rece□t o□ □E sam□les □ith actual environmental media sam□ling□ □n most instances, □E sam□les □ill be submitted concurrently □ith environmental media sam□les□ □n other cases □e□g□, □re□uali□ication□, the □E sam□les may be submitted to selected laboratories individually to assess laboratory □er□ormance□

□□□□□□ □E sam□le selection should be based on □ro□ect D□□s□□E sam□les are ty□ically submitted □or the entire suite o□ analytes□ □he concentration ranges □or the di□□erent analytical grou□s should be selected based on the e□□ected concentration ranges at the site□ □ list o□ recommended un□no□n constituents has been □re□ared to □acilitate the selection o□ the □E sam□le □arameters□ □he selection o□tions are □resented in the □□ab □er□ormance Sam□le Matri□□□hich is also attached□

□□□□□□ □he decision to use laboratory□su□□lied bottle□are or □E vendor su□□lied bottle□are is □ro□ect s□eci□ic and may de□end on □hether the □E vendor can □rovide identical bottle□are to the laboratory□ Note: □□the □E vendor cannot □rovide bottle□are identical to that □rovided by the analytical laboratory, use o□ bottle□are su□□lied by the □E vendor instead o□ the analytical laboratory may result in the □E sam□le being classi□ied as □single blind□□

□□□□ □ontact □ccredited □aboratory □□E □endor□

□□□□□□ □lace order □or □E sam□les selected □ith □E vendor several days in advance□ □n most cases, the vendor selected □ill be Environmental □esource □ssociates □E□□□o□□rvada, □□□

□□□□□□ E□mail or □a□a co□y o□a □urchase order, and an e□□lanatory cover letter or order □orm to the □E vendor□ E□am□les o□ these documents are included in □ttachment □□ □he cover letter or order □orm should detail the date the □E sam□les are needed and re□uest that the □E sam□les be shi□□ed the same day they are □re□ared□ □lso, i□ laboratory□su□□lied bottle□are □ill be □rovided to the □E vendor, the cover letter or order □orm should detail □hen the bottle□are □ill be sent to the □E vendor□

5.2.3. A tem□erature blan□ must accom□any the bottle□are and □E sam□les. □he tri□blan□ and the tem□erature blan□ are o□□aramount concern i□you are also sending sam□le □ars □or volatile organic com□ound (VOC) analysis □e□g., 4) ml VOA vials) to the □E manu□acturer. □e□er to SOP □D 1)005, *Quality Assurance/Quality Control Measures for Field Sampling Activities*.

5.2.4. □he date that □E sam□les □ill arrive □or □rocessing should be correlated □ith any sam□ling activities that are to be conducted so the □E sam□les can be submitted concurrently □ith environmental media sam□les.

5.2.5. □rrangements should be made so that the □E sam□les are received on the same day that □ield activities are conducted. □he laboratory should be noti□ied that analyses should be □er□ormed on a shorter holding time. □his is im□ortant since the □E sam□les are being □re□ared a day earlier and the holding time e□□iration is one day ahead o□the □ield sam□les.

5.2.6. □void re□uesting recei□t o□□E sam□les on Monday, as this □ill shorten the VOC holding time by 3 days.

5.2.7. □dhere to vendor s□eci□ic re□uirements regarding □E sam□le bottle□are. □endors may have bottle□are similar in si□e and color to the analytical laboratory analy□ing the sam□les or may re□uire em□ty laboratory bottle□are in □hich to □lace the □E sam□le.

5.2.8. Submit a □a□er□or□ re□uest to the LEA □ro□ect chemist □or a□□licable □ield □a□er□or□ and sam□le labels □or □ield sam□ling activities, or □ust □or □E sam□les i□no concurrent sam□ling is to be conducted).

5.3. Sending Sam□le □ars to □E □endor i□a□□licable)

5.3.1. □lace a bottle order □ith the analytical laboratory, re□uesting the a□□ro□riate bottles □or the environmental analyses selected, based on the environmental media and the intended analytes o□the sam□ling □rogram that is to be underta□en.

5.3.2. □nce the em□ty bottles are received □rom the analytical laboratory select the a□□ro□riate glass□are □or the □E sam□le constituents.

5.3.3. □ac□ em□ty bottles in bubble □ra□, including a tri□blan□ i□sam□les □ill be submitted □or analysis o□VOC s) and a tem□erature blan□.

5.3.4. □ill out a□chain o□□custody □orm □or the bottles you are sending to the □E vendor. Send the original chain o□custody □ith the cooler and □ee□ a co□y o□the chain o□custody □or your records.

□□□□ □eceiving □E sam□le □rom the □E □endor

□□□□□□ □□on rece□i□t o□the cooler, chec□the custody seals□

□□the custody seals are damaged, contact the □ro□ect manager and the □ro□ect chemist to evaluate □hether a re□lacement □E sam□le is needed□

□□□□□□ □□en the cooler and measure□ the tem□erature o□ the tem□erature indicator□ □ecord the tem□erature on the □orm □rovided by the vendor and sign the □orm□ □his needs to be done as soon as the cooler is received□ □s a□□licable, return the cooler to the □E vendor□

□□the tem□erature blan□e□ceeds □°□, contact the □ro□ect manager and the □ro□ect chemist□ □he □E sam□le may not be valid, □articularly i□a □□□ □E sam□le is included□ □□this is the case, contact the □E vendor to re□uest a re□lacement□ □o □revent this □rom ha□□ening to the e□tent □ossible, the cooler should be o□ened, and the tem□erature should be recorded as soon as □ossible a□ter rece□i□t by □E□□

□□□□□□ □lace the □E sam□les in a tem□erature□controlled container□ □he container must be □e□t at a tem□erature o□ □□□ □ □□□ □riginal tri□ blan□s i□ included□must be □e□t □ith the □E sam□les□

□□□□□□ □he chain□o□□custody □orm □or the sam□les □ill be □e□t □ith the sam□les □hile they are stored in the tem□erature□controlled container□ Maintain that chain□o□□custody □orm □rom the □oint that the □E sam□les enter □E□□s custody until the sam□les are released to the chain□o□□custody □orm that □ill accom□any the sam□les to the laboratory□

□□□□□□ Do **not** remove the sam□le labels/tags yet that are attached by the □E vendor□ □hese tags are the only indication o□□hat constituents have been s□i□ed into the bottles□ □his is □articularly critical □or S□□□s and □□□s since the bottles are generally identical and un□reserved□

□□□□ Shi□□ing □E Sam□les to the □nalytical □aboratory

□□□□□□ □emove the □E sam□le □rom the tem□erature□controlled container □ith any accom□anying □□/□□ sam□les □e□g□, tri□ blan□□□ □elease the sam□les □rom the □E chain□o□□custody □orm to the chain□o□□custody □or the □ield sam□les and □ile this □a□er□or□a□□ro□riately□

□□□□□□ □□a □E sam□le □ill be submitted to the analytical laboratory □ith □ield environmental sam□les, add the □E sam□le to the original *Field Sampling*

□ □□the cooler tem□erature indicator is a tem□erature blan□, use a thermometer to measure tem□erature□

Record□ □hen a □E sam□le is being added to an original *Field Sampling Record* ma□e sure to include the a□□ro□riate sam□le class identi□ier□ □ater □E sam□le □□E□ □and soil □E sam□le □□ES□are the t□o sam□le classes used in the □E□ databases□ □□a □□□ □E sam□le is being submitted □or analysis, the tri□ blan□ □or the □E sam□le □ill be submitted □or analysis along □ith the □E sam□le, in addition to any tri□ blan□s included □or the □ield sam□les□

□□□□□□ □he □rocedure described in this section should be □itnessed by t□o em□loyees, □ho □ill each sign the □E sam□le □re□aration □orm□ □abel the glass□are □ith dedicated □E□ sam□le labels, including any accom□anying □□/□□ sam□les□Dedicated means that all o□the sam□le □ars, □or both soil and □ater, should have se□arate sam□le numbers □or each ty□e o□analysis□ □his is to ensure that there □ill be no sam□le selection errors by the analytical laboratory□ □Note: □ ater □□□ sam□les are usually collected in the same ty□e o□bottle as S□□□ sam□les□Soil sam□les □or most analyses are collected in similar □ars□□ **Only remove the PE manufacturer's labels after the LEA sample labels are affixed and checked.**

□□□□□□ □ rite the □E□ sam□le number on the vendor label and then remove the tag□ □a□e all original vendor tags onto the □□ield Sam□ling □ecord □ □er□ormance Sam□le□to be □iled in the □ro□ect noteboo□□ □his □ill serve as a cross□re□erence □or □E□ sam□le number, constituent□s□and vendor lot number □or □uture re□erence□ □ co□y o□ the □orm is □rovided in □ttachment □□

□□□□□□ □are□ully transcribe the □E□ sam□le number □rom the label that has been a□□i□ed to the □ar onto the □ield □a□er□or□ as each vendor label is removed□ □ rite the constituent □e□g□, □□□□s, S□□□s□ne□t to the sam□le number on the □ield □a□er□or□□ □lso, □rite the vendor□s name and □E lot number on the □ield □a□er□or□□

□□□□□□ □nclude the □E sam□les on the chain□o□□custody □a□er□or□□ **This chain-of-custody form is different than the one used to ship and receive the glassware from the PE vendor.** □nclude a sam□le matri□ code a□□ro□riate to the ty□es o□□ield and □E sam□le, as indicated in the table belo□:

Sam□le Matri□	□i□uid □E Sam□les	Solid □E Sam□les
□i□uid □ield Sam□les	□se the same matri□code as the □ield sam□les □e□g□, □ □ □ground□ater□or □ S □sur□ace □ater□□□	N/□
Solid □ield Sam□les	□se the matri□code □or li□uid sam□les that may be collected at the same time as the solid sam□les □e□g□, □ □ □ground□ater□□ith soil □S□□ sam□les or □ S □sur□ace □ater□□ith sediment □SE□sam□les□□	□se the same matri□code as the □ield sam□les □e□g□, S□ □soil□or SE □sediment□□□

□□□□□□ □ave another □E□ em□loyee chec□ the cooler chain□o□□custody □orm □or accuracy and have that □erson initial the chain□o□□custody □orm□

□□□□□□ □ile co□ies o□all a□□licable □ield sam□ling □a□er□or□ including the □age □ith the original vendor□s tags ta□ed to it□

□□□□ □esult □nter□retation

□□□□□□ □nce the □E sam□le results re□orted by the laboratory are entered into the □ro□ect□s□eci□ic database, it should be veri□ied □or accuracy against the hard co□y laboratory re□orts□ Similarly, once the vendor□s□eci□ied acce□tance limits and □true□ values are entered in the database, they should be veri□ied against the hard co□ies □or accuracy□

□□□□□□ □nce the data in the □ro□ect□s□eci□ic database have been veri□ied □or accuracy, com□are the laboratory □E sam□le results to the vendor□ s□eci□ied acce□tance limits□ Submit any □□□□□□ or □□□□SE NE□□□□□□E/□□S□□□□E□in□ormation to the analytical laboratory so they can chec□ □or □ossible errors and re□ort any corrective actions ta□en□ □lease note that in some instances, the client may limit the amount o□ in□ormation re□orted to the laboratory to only the □□□□□□ and □□□□SE NE□□□□□□E/□□S□□□□E□designation□ □he in□ormation re□orted bac□ to the laboratory is □ro□ect s□eci□ic□

6. References

E□□□*Guidance on Technical Audits and Related Assessments for Environmental Data Operations*, E□□ □□/□□□, □inal □E□□/□00/□□□□/0□0□□anuary □000□

E□□□ *Uniform Federal Policy for Quality Assurance Project Plans – Evaluating, Assessing, and Documenting Environmental Data Collection and Use Programs.* March □00□□

END □□D□□□MEN□

ATTACHMENT 1

PE Sample Ordering Information

SOIL - BLIND PERFORMANCE SAMPLES					
	VOCs	SVOCs	METALs	TPH	PCBs
LOT #	1	2	3	4	5
A	Stock Lot - 1 of 11 available	Stock Lot - 1 avail = 4/year	Stock Lot - 1 of 2 available	Stock Lot - 1 of 3 available	Stock Lot - 1260 Low 1 avail = 4/year
B	Stock Lot - 2 of 11 available	Stock Lot - 1 avail = 4/year	Stock Lot - 2 of 2 available	Stock Lot - 2 of 3 available	Stock Lot - 1254 Low 1 of 3 available
C	Stock Lot - 3 of 11 available	Stock Lot - 1 avail = 4/year	Stock Lot - 1 of 2 available	Stock Lot - 3 of 3 available	Stock Lot - 1248 Low 1 of 2 available
D	Stock Lot - 4 of 11 available	Stock Lot - 1 avail = 4/year	Stock Lot - 2 of 2 available	Stock Lot - 2 of 3 available	Stock Lot - 1254 Low 2 of 3 available
PRICE	$295 each	$261 each	$215 each	$107 each	$215 each

WATER - DOUBLE BLIND SAMPLES					
	VOCs	SVOCs	METALs	TPH	PCBs
LOT #	1	2	3	4	5
A	TCE = 25 ug/l	Bis (2) = 50 ug/l	Cr = 0.4 mg/l	1 mg/l	1260 = 1.4 ug/l
	PCE = 50 ug/l	NAP = 75 ug/l	Zn = 0.5 mg/l		
	VC = 80 ug/l	PYR = 125 ug/l			
B	TCA = 25 ug/l	BAP = 10 ug/l	As = 0.2 mg/l	0.7 mg/l	1248 = 0.8 ug/l
	PCE = 100 ug/l	BBF = 10 ug/l	Pb = 0.5 mg/l		
	MC = 25 ug/l	PHN = 5 ug/l			
C	BZ= 5 ug/l	ANTH = 150 ug/l	Cd = 0.1 mg/l	2 mg/l	1260 = 1 ug/l
	EBZ = 75 ug/l	Bis (2) = 100 ug/l	Hg = 0.01 mg/l		
	TL = 100 ug/l	DBP = 5 ug/l			
D	MC= 50 ug/l	FA = 35 ug/l	Ba= 1 mg/l	5 mg/l	1254 = 0.7 ug/l
	ACT = 125 ug/l	FLE = 50 ug/l	Ni = 0.20 mg/l		
	PCE = 25 ug/l	BA = 5 ug/l			
PRICE	$216-B,C,D ($266-A)	$216 each	$155 each	$115 each	$126 each

LIST OF ABBREVIATIONS:

TCE = Trichloroethylene
PCE = Tetrachloroethylene
VC = Vinyl chloride
TCA = 1,1,1-Trichloroethane
MC = Methylene chloride
BZ = Benzene
EBZ = Ethylbenzene
TL = Toluene
ACT = Acetone
Bis (2) = Bis(2-ethylhexyl) phthalate
NAP = Napthalene
PYR = Pyrene
BAP = Benzo[a]pyrene
BBF = Benzo[b]fluoranthene
PHN = Phenanthrene
ANTH = Anthracene
DBP = Di-n-butyl phthalate
FA = Fluoranthene
FLE = Fluorene
BA = Benzo[a]anthracene

FACSIMILE TRANSMITTAL SHEET

Loureiro Engineering Associates, Inc.

TO:	**Dale Shallenberger**	FAX NUMBER:	**303-421-0159** **303.421.3062 (lab)**
COMPANY:	**ERA**	DATE:	**12/04/2001**
FROM:	**Nick Skoularikis**	NO. OF PAGES (including cover):	**3**
RE:	**PE sample preparation**	LEA REFERENCE NUMBER:	

☐ URGENT ☐ FOR REVIEW ☐ FOR YOUR USE ☐ PLEASE COMMENT ☐ PLEASE REPLY

NOTES/COMMENTS:

Dale

I am shipping the cooler with the glassware today. Please call tomorrow if there are any questions.
I am attaching the PO # 6312 and the solution types to be used.
Please reference the PO# in the invoice. Also add the Commission Number: 68VD134.001
Please use Lots A and B.
The lab needs the following jars per sample:

- 3 VOA vials
- Two 1-Liter for TPH
- Two 1-Liter for SVOCs
- Two 1-Liter for PCBs
- One 1-Liter for Cyanide
- Two for metals (one for filtered and one unfiltered)

Please ship overnight on Monday 8/6/01 and on Tuesday 8/7/01 (one each) for receipt the following day.

Thanks
Nick

Loureiro Engineering Associates, Inc.

PURCHASE ORDER

Loureiro Engineering Associates, Inc. 100 Northwest Drive Plainville, CT 06062 Phone: (860) 747-6181 Fax: (860) 747-8822	**Purchase Order Number: 6312**

Date: 12/04/01	**Ordered By: Nick Skoularikis**
	Approved By: Nick Skoularikis

Commission Number 68VD135	**Task Number** 001

Company **Env Resource Associates** Street Address/P.O. Box 5540 Marshall street City/State/Zip Code Arvada, CO 80002 Phone 800.446.8736 Fax

LEA, Plainville CT, Nick Skoularikis Company Attention Loureiro Engineering Assoc., Inc. Street Address/P.O. Box 100 Northwest Drive City/State/Zip Code Plainville, CT 06062 Phone 860/ 747-6181 Fax 860/747-8822 Shipping/Delivery Instructions: Overnight ,

CODE	QTY	PART NO.	DESCRIPTION	PRICE (EA)	AMOUNT
	2	Lots B,C	VOCs, aqueous PE sample	232	464
	2	Lots A, B	SVOCs, aqueous PE sample	232	464
	2	Lots A, B	Metals aqueous PE sample	170	340
	2	Lots A, B	TPH aqueous PE sample	125	230
	2	Lots A, B	PCBs aqueous PE sample	126	252
	2	Lots A,B	CN aqueous PE sample	89	178
			Plus shipping charges (FedEx Overnight)		
				SUBTOTAL	1928
				FREIGHT	
				TAX RATE	6.000%
				TAX	
				TOTAL DUE	

ATTACHMENT 2

Field Sampling Record
Performance Sample

Loureiro Engineering Associates, Inc.

FIELD SAMPLING RECORD
PERFORMANCE SAMPLE

LEA Comm. No.	**67PV102.001**	Page _____ of _____
Project		Date ___/___/____
Location	Plainville Landfill, Plainville, CT	
Client	Town of Plainville	

LEA Sample ID _____

LEA Sample ID _____

LEA Sample ID _____

LEA Sample ID _____

LEA Sample ID _____

LEA Sample ID _____

Field Personnel	_____	_____	***Signature***
	_____	_____	_____

Loureiro Engineering Associates, Inc.
Standard Operating Procedure
for
Documentation and Integrity
of
Field Sampling Activities

SOP ID: 10038
Date Initiated: 04/30/99
Revision No. 004: 09/04/18

Revised By:	***/s/Jeremy Marcantonio***	***02/28/18***
	Jeremy Marcantonio	**Date**
	Senior Project Scientist	
Reviewed By:	***/s/Jo Ann Robertson***	***09/04/18***
	Jo Ann Robertson	**Date**
	Technical Associate	
Approved By:	***/s/Karen Harris***	***09/04/18***
	Karen Harris	**Date**
	Quality Assurance Manager	

REVISION RECORD

Rev #	Date	Additions/Deletions/Modifications
Initial Issue	04/30/99	
001	12/31/01	Formatting and minor revisions throughout
002	08/09/02	Added requirement for briefing or written work instructions prior to sampling; Added section on field equipment request and vehicle request; Added section on chain-of-custody form; Added section on cooler integrity and shipment.
003	07/18/18	Revisions throughout. Update to reflect new SOP format and updated sampling methodologies.
004	09/04/18	Updated to include documentation of sample coordinates and photographing samples.

Loureiro Engineering Associates, Inc.
Standard Operating Procedure
for
Documentation
of
Field Sampling Activities

1. Purpose and Scope

This document describes procedures to be followed for proper documentation of all activities associated with sampling of environmental media, including field measurements and sampling, quality assurance/quality control (QA/QC) sample documentation, and chain-of-custody protocols. The use of specific documentation procedures depends on the goals of a particular project and should be dictated by the project-specific documents (e.g. work plan, FSP, QAPP). This Standard Operating Procedure (SOP) is to be used in conjunction with other Loureiro Engineering Associates, Inc. (LEA) SOPs and guidance for the performance of the associated field sampling activities.

2. Related Standard Operating Procedures

- 10030 – Processing Performance Evaluation Samples
- This SOP relates to all sampling, descriptive, and operational SOPs.

In addition to the above-noted SOPs, project and client-specific requirements may be applicable to individual projects and should be discussed with the Project Manager and incorporated into the project specific documents for adherence during the execution of the project.

3. Definitions

None.

4. Equipment

The following equipment and supplies shall be used during documentation of field sampling activities, as required:

- Pens
- Clipboard
- Field paperwork
- Indelible marker

- Camera

5. Procedures

5.1. Field procedures for which documentation covered under this SOP is required include sampling of soil, groundwater, air, surface water, sediment, and any other media from which samples are collected, as well as associated activities.

Documentation to be provided will include:

- Summary of daily field activities. (i.e., but not limited to: date, onsite/offsite time, client/office interactions, site visitors, changes in scope, out of the ordinary situations, changes in health and safety situations)
- Sample descriptions (Location ID, Sample ID, Depths, PID, and other observations)
- Photographic log
- Coordinates and elevation of sample locations. Include the datum and accuracy of the method
- Deviations from project scope and SOPs
- Equipment used
- Instrument calibration form
- Waste disposal form
- Decontamination procedures

5.2. All relevant information shall be included on the appropriate field report forms. However, the chain-of-custody record will include only that information necessary for proper sample identification and analysis.

5.3. Field Activities Documentation

5.3.1. The purpose of field paperwork is to adequately document all field activities. It is important to document field conditions that may have an impact on the field activities, such as weather conditions, physical constraints, nearby construction or dewatering activities (to the extent known).

5.3.2. All field paperwork must be filled out accurately and be completed in the field before the end of the workday. The only exception is the preparation of performance evaluation (PE) samples at the office, which should be completed in the office after the PE samples have been properly labeled in accordance with SOP 10030 *Processing Performance Evaluation Samples*. Information on equipment and expendable item usage shall be completed during the day, but checked for omissions at the end of the day.

5.3.3. At the conclusion of each sampling day, the field personnel shall conduct a quality control review before leaving the field, using the Quality Assurance Checklist section of the Daily Field Report.

5.4. Chain-of-Custody Form

Although the chain-of-custody forms vary between laboratories and the analyses requested vary on a project-specific basis, the following information should be provided on the chain-of-custody forms:

5.4.1. Specify the LEA seven-digit sample number, date and time of collection, sample matrix, the type of analyses requested, and the preservatives used. For aqueous samples, the information provided should clearly indicate which preservative is used for which analyses. The analytical method requested should be specified.

5.4.2. The cooler containing the samples should be labeled with the appropriate identification information as specified in the project specific documents.

5.4.3. Specify whether an electronic data deliverable (EDD) or data validation package is required.

5.4.4. Specify the laboratory quote number or any additional project-specific numbers.

5.4.5. Unless otherwise specified in the site-specific project documents, use the suffix “uf” after the seven-digit LEA sample number to denote unfiltered metal samples.

5.5. Photograph Log

Photographs will be taken of the following:

- The area the samples will be collected from (before and after sampling)
- Sampling process (periodically)
- Each of the soil and sediment samples
- Site conditions (daily)
- Location of the dust and VOC monitors
- Waste disposal area (periodically)
- Decontamination area and during the decontamination process (periodically)

Photographs will be logged in the field notes. The direction of the photograph and coordinates will be recorded in the photo log or recorded on the photograph using Solocator or similar software. Photographs of samples will include a scale and

sample identification. Photography is restricted at some job sites and the use of photography should be discussed with Project Manager.

5.6. Post Field Activities

- Ensure that the paperwork is complete and that the pages are numbered sequentially, and dates are accurate.
  - Verify that all waste container information has been recorded.
- Appropriate entries should be made for all visitors to the site related to the field activities performed.
- Document in the photograph log the location of each the photograph or what the photograph is of. Photographs and log will be submitted to the data manager.
- Upon completion of the daily field activities and after review of the completed paperwork, a copy of the field paperwork shall be submitted to the database manager. The originals shall be retained for filing in the project notebook.
- All required information from the field is entered into the database by the database manager or a designee. A data review checklist is printed out upon completion. Included with the data review checklist may be a comment sheet indicating inconsistencies in the data entered that were readily apparent based on electronic comparison of the data or noted by personnel entering the data.

6. References

ATSM. ASTM 4840-99 *Standard Guide for Sampling Chain of Custody Procedures.* Reapproved in 2010.

END OF DOCUMENT

ATTACHMENTS AND FORMS

Loureiro
Engineering • Construction • EH&S • Energy
Waste • Facility Services • Laboratory

DAILY FIELD REPORT

LEA Comm. No. Page _____ of _____
Project Date ___/___/_____
Location
Client

Arrived at Site _____ Departed from Site _____ Vehicle _____
Odometer (Start) _____ Return _____

Site Activities

- ☐ Soil Sampling
- ☐ Groundwater Sampling
- ☐ Surface Water Sampling
- ☐ Vapor/Air Sampling
- ☐ Concrete Sampling
- ☐ Other Sampling
- ☐ Other Sampling
- ☐
- ☐ Well Development
- ☐ Geoprobe Work
- ☐ Concrete Coring
- ☐ Construction
- ☐ Waste Management
- ☐
- ☐ Inspection
- ☐ Site Walk Over
- ☐ Surveying
- ☐ Other (Describe)

Current Project Information

Last Sample Number Used _____
Last Location ID Used _____
Current Location (if not complete) _____
Sampling for _____
Laboratories used _____
Paperwork & Equipment left at/in _____
Site Contact _____
Contractors on Site _____
_____
Time and place to meet contractors _____
_____

Non-productive Time

- ☐ None
- ☐ Equipment Breakdown
- ☐ Late
- ☐ Weather
- ☐ Missing Equipment
- ☐ Other (Describe)

Quality Assurance Checks

Yes	N/A	No	
			Sample labels complete
			Sample/cooler seals OK
			All samples obtained
			Chains of custody
			All forms/logs complete
			Site condition OK
			Site H&S Plan on site
			Instruments calibrated

Residuals Disposition

Item	Approx. Amount	Container ID
Soil/Solid		
Groundwater		
Decon Fluid		
PPE		
Other		

Weather Conditions

Temperature _____ Precipitation _____ Wind _____
Comments

Checked By

_____

Expendable Items Used

Qty	Item	LEA Number
	Bailer, 2 Part Product	197
	Bailer, Disposable (specify size)	090
	Bailer, PVC, 1"	187
	Bailer, PVC, 1-1/2"	026
	Bailer, PVC, 2"	018
	Bailer, Stainless, 2"	027
	Bailer, Teflon	059
	Decontamination Supplies	081
	Filter, In Line	024
	Filter, Zap Cap	024
	Foot Valve and/or Surge Bloc	194
	Miscellaneous Health & Safety Items	060
	Tubing, 1/2", NOS	007
	Tubing, 3/8", NOS	008
	Water, Distilled	025

Equipment Used

Qty	Item	LEA Number
	Bomb Sampler	042
	Meter, Conductivity	022
	Meter, pH/Temp	021
	Miscellaneous Small Tools & Equipment	152
	Pump, Peristaltic (spec. Master or Isco)	040
	Pump, Watera	038
	Turbidimeter	023
	Water Sampling Kit	152

Field Personnel _____ _____ ***Signature***
_____ _____ _____

Loureiro Engineering Associates, Inc.
Standard Operating Procedure
for
Low-Flow (Low-Stress)
Liquid Sample Collection and Field Analysis

SOP ID: 10039
Date Initiated: 06/11/01
Revision No. 006: 07/19/18

Revised By:	***/s/ Daniel J. Hagen***	***02/09/18***
	Daniel J. Hagen	**Date**
	Project Scientist	
Reviewed By:	***/s/ Jo Ann Robertson***	***07/18/18***
	Jo Ann Robertson	**Date**
	Technical Associate	
Approved By:	***/s/ Karen Harris***	***07/19/18***
	Karen Harris	**Date**
	Quality Assurance Manager	

REVISION RECORD

Rev #	Date	Additions/Deletions/Modifications
Initial Issue	06/11/01	
001	04/01/02	Updated to reflect new SOP format.
002	12/02/02	Updated to reflect stabilization procedures.
003	04/01/05	Incorporated modified low-flow sampling procedure to include the use of a peristaltic pump.
004	08/09/11	Allowed use of plastic tub as secondary containment. Provided equation for standing water calculation. Required recording of depth of pump intake. Required direct calculation of flow rate. Minor wording changes to improve precision. Deleted reference since it has been rescinded: [Connecticut Department of Environmental Protection, Bureau of Water Management, Permitting Enforcement and Remediation Division. *Site Characterization Guidance Document*, Draft, June 12, 2000.]
005	04/01/12	Added unit conversion information from gallons to liters.
006	07/19/18	Removed instructions that are provided in separate SOPs and added references to related SOPs.

Loureiro Engineering Associates, Inc.
Standard Operating Procedure
For
Low-Flow (Low-Stress)
Liquid Sample Collection and Field Analysis

1. Purpose and Scope

This standard operating procedure (SOP) describes the procedures to be followed for measurement of static water-level elevations, detection of immiscible layers, well evacuation, sample withdrawal, and field analyses utilizing low-flow sampling techniques.

2. Related Standard Operating Procedures

- 10004 – Liquid Sample Collection and Field Analysis
- 10005 – QA/QA Measures for Field Sampling Activities
- 10038 – Documentation and Integrity of Field Sampling Activities
- 10059 – Management of Investigation Derived Waste
- 10065 – Decontamination of Field Sampling Equipment

In addition to the above-noted SOPs, project and client-specific requirements may be applicable to individual projects and should be discussed with the Project Manager and incorporated into the project specific work plan (Work Plan) for adherence during the execution of the project.

3. Definitions

- Immiscible layers: The term is used to denote separate-phase liquids that may be present in the aquifer as a result of a release. These liquids may have a density lighter than water (light non-aqueous phase liquids [LNAPL], which float) or heavier than water (dense non-aqueous phase liquids [DNAPL], which sink).

4. Equipment

The following equipment and supplies shall be used during the collection and field analysis of low-flow liquid samples, as required:

- Health and safety equipment (as required by the site-specific Health and Safety Plan [HASP])
- Electronic water-level indicator (accurate to 0.01 foot)

- Photoionization Detector (PID) and calibration kit
- Interface probe/clear view bailer (to check for non-aqueous phase liquids, as appropriate)
- Water quality meter capable of monitoring (at a minimum) pH, temperature, specific-conductance, oxidation reduction potential (Eh), and dissolved oxygen (DO) and calibration fluids
- Flow-through cell
- Turbidimeter
- Polyethylene plastic sheeting and secondary containment units (plastic tubs)
- Adjustable rate centrifugal pump, peristaltic pump, bladder pump (constructed of stainless steel or Teflon®), adjustable rate submersible pump, or adjustable rate centrifugal pump. The preferable style of pump to be used is project specific and will be determined in the site-specific Work Plan
- Bladder pump control units for Nitrogen and Carbon Dioxide Tanks, and electronic and gas operated air compressors (if needed)
- Appropriate tubing for the pump used based on project specific sampling requirements, or polyethylene tubing, silicone tubing for the peristaltic pump. Note: Teflon® or Teflon®-lined tubing is not to be used when sampling for polyfluorinated alkyl substances (PFAS) compounds
- Hand tools for opening well
- Graduated measuring cup
- Decontamination fluids
- Watch

5. Procedure

5.1. Site Preparation

Review and follow the health and safety procedures or requirements specified in the site-specific HASP. All necessary personal protective equipment (PPE) shall be donned as specified in the site-specific HASP.

5.2. Equipment Decontamination

5.2.1. All reusable equipment will be decontaminated prior to starting and in between groundwater low flow sampling in accordance with SOP 10065 *Decontamination of Field Sampling Equipment* or as otherwise specified in the site-specific Work Plan or Field Sampling Plan (FSP).

5.2.2. Materials such as the bailer cord should not be decontaminated and should just be disposed of after each test. Note: Bailers should be used **only** to check for LNAPL **before** sample collection using low-flow/low stress procedures. A bailer may be used to check for DNAPL

only **after** all sample collection equipment has been removed from the well.

5.3. Approaching the Monitoring Well

5.3.1. Make sure the well is properly labeled if there can be any question about the well I.D. based on location (i.e., more than one well in close proximity to each other). If the well cannot be clearly identified, either based on location or by a specific label of some kind on the well itself, clearly indicate that fact on the field sampling record, water-level measurement form, and/or field paperwork. Well IDs may be located on the concrete collar of the monitoring well, on the protective casing of the monitoring well, or on the locking cap of the well. Should an ID not be easily visible, a measurement of depth-to-bottom of the well can be made in an attempt to clarify the well ID, in a manner not to mobilize any settled particulate in the bottom of the well. If the well historically contains a significant amount of settle particulate matter, the depth-to-bottom measurement should be taken after the well is sampled, as indicated in Section 5.4.4.

5.3.2. Each well shall have a surveyed reference point located at the top of the well casing with the locking cap removed. The reference point shall be easily recognizable, since the personnel conducting the sampling may differ from one sampling event to the next.

5.3.3. Remove the protective cover and locking cap from the well using hand tools.

5.3.4. Immediately upon opening the well, the air in the well head will be screened for VOCs using a PID. The instrument shall be zeroed with ambient air prior to the measurement, and the highest reading observed shall be recorded for each well. Measurements should be taken until stabilization of the readings has occurred.

5.4. Measurement of Static Water Level

5.4.1. The static water-level depths in each well shall be measured prior to each sampling event. This is performed initially to characterize the site, and in subsequent sampling rounds to determine whether horizontal or vertical flow gradients have changed. A change in hydrologic conditions may necessitate modification of the groundwater monitoring program.

5.4.2. The following parameters shall be measured with an accuracy of 0.01 foot:

- Depth to standing water.
- Depth to bottom of well (after all liquid samples have been collected from the well if the depth to bottom cannot be collected during the initial round of waterlevels).

5.4.3. A water-level indicator with a fiberglass tape will be used for measurement. As a result of possible pressure differences between the well atmosphere and the ambient atmosphere, the water level will be allowed fifteen minutes to equilibrate upon removal of the well cap. If excess pressure is encountered, the water level will be allowed greater than fifteen minutes to equilibrate upon removal of the well cap. The results shall be recorded on the appropriate field form(s).

5.4.4. Total depth measurements will be compared to original depths to determine the degree of siltation that may have occurred. This information shall be noted on the field forms. Should significant siltation occur in any well, the well shall be redeveloped by an approved method.

5.4.5. The portion of the tape immersed in the well shall be decontaminated during retrieval using an alconox wash, a distilled water rinse followed by drying with a clean wipe, prior to use in another well. This decontamination procedure shall be amended, as needed, to accommodate the specific type of contamination anticipated.

5.4.6. The static water level should be monitored and recorded throughout the purging and sampling of each well.

5.5. Detection of Immiscible Layers

5.5.1. If LNAPL is detected in a well, collection of a groundwater sample from that well is not recommended unless otherwise specified in the site-specific Work Plan. However, if a groundwater sample must be collected from that well, low-flow sampling is the recommended technique, although care must be taken to minimize mobilization of the LNAPL into the zone from which the sample will be collected. This is best accomplished by ensuring that the tubing or pump intake is placed well below the interface between the separate phase liquid and the water in the well.

5.6. Field Analysis

5.6.1. Parameters that are physically or chemically unstable shall be measured using probes that are inside a flow-through cell. Such parameters as pH, temperature, specific conductance, DO, Eh, and turbidity will be measured in the field at the temperature of the well sample.

5.6.2. Parameters such as pH, temperature, specific conductance, DO, and Eh shall be measured using a transparent flow-through-cell. The meter shall be calibrated immediately prior to use, if conditions change, and at the end of the day using supplied solutions in accordance with the instructions provided by the manufacturer. Calibration information will be recorded in the field before and after each calibration.

5.6.3. Turbidity will be measured with a separate turbidimeter, although some flow-through cells include a turbidimeter. It is useful to have a separate turbidimeter on hand to check the validity of the turbidity values obtained using the flow-through cell if there is difficulty reaching low turbidity values or if the turbidity readings recorded do not seem to be consistent with visual observation of the water samples. All samples, including turbidity samples and samples to be submitted for analysis, must be collected before the groundwater passes through the flow-through cell to prevent cross-contamination by potentially stagnant fluid within the flow-through cell. This can be accomplished by using a bypass assembly or disconnecting the tubing from the flow-cell inlet prior to sampling.

5.7. Well Evacuation

5.7.1. Generally, a centrifugal, peristaltic pump, bladder, submersible, or air-lift pump equipped with appropriate tubing of inert materials (such as polyethylene), shall be used to evacuate the monitoring wells.

5.7.2. A new piece of polyethylene plastic sheeting shall be placed on the ground adjacent to the well. Sampling and purging equipment such as the pump, tubing, containers, etc., shall be placed on the polyethylene sheet and/or a plastic secondary containment unit, never on the ground.

5.7.3. The pumps and tubing shall be prepared for insertion into the well while wearing disposable gloves. Make sure that any tubing or pump apparatus is of sufficient length to reach the appropriate depth for pumping. The water receiving tubing line should be kept out of direct

sunlight, as to avoid heating of the purged groundwater to cause a potential loss of VOCs.

5.7.4. Lower the pump and/or tubing gently into the water column to the midpoint of the saturated portion of the screened interval, unless otherwise specified. A site-specific sampling plan may specify a specific sampling depth, or provide specific criteria for the selection of intake depth for each well, but as a default, the tubing/intake should be placed at the midpoint of the saturated portion of the screen. **Record the actual depth at which the tubing/intake is placed.** If the saturated portion of the screen is less than 3 feet, the tubing or pump intake should be placed no closer than 1 foot from the bottom of the well. If the column of water in the well is less than 6 inches, serious consideration must be given to sampling the well, since it is not clear that the water in the well will be representative of water in the aquifer. If samples are collected from a well under these conditions, the limited volume of water should be specifically noted in the field paperwork.

5.7.5. Start the pump at the lowest speed setting and slowly increase the speed until discharge occurs. The initial pumping rate shall be approximately 0.1 liters per minute, however, the pumping rate shall not exceed 0.25 liters per minute. Measure the water level to ensure that drawdown in excess of 0.3 feet does not occur in the well. Adjust the pumping rate as necessary until little or no drawdown occurs. At least one actual measurement of the pumping rate should be conducted once drawdown stabilizes. That measurement should be made using a suitable measurement device for the volume anticipated over a measurement period of at least 20 to 30 seconds. Record the actual pumping rate on the field sampling record.

5.7.6. If the drawdown exceeds 0.3 feet, reduce pumping rate if possible. If drawdown still does not stabilize at a depth above the pump intake, shut the pump down and allow the well to recharge. It should be noted that a stable drawdown of approximately 0.3 feet is desirable but not mandatory. Stabilization of the drawdown at a depth greater than 0.3 feet is acceptable, as long as the depth at which stabilization occurs is above the pump intake. However, it is important that the stabilization depth is clearly recorded and maintained.

5.7.7. Monitor and record the water level and pumping rate at a minimum of every three to five minutes during purging. Calculate the volume of

the discharge tubing, bladder pump (if used), and the flow-through cell. Monitor and record indicator field parameters (turbidity, pH, Eh, DO, temperature and specific conductance) in the well from the first water extracted during the purging process and at least every three to five minutes, or sufficient time to purge at least one flow cell volume thereafter. During monitoring, place the flow-through cell in a position to prevent the possibility of gas bubble entrapment. It may be beneficial to place it at a 45 degree angle while monitoring groundwater parameters. When recording field measurements, follow the SOP 10038 *Documentation and Integrigty of Field Sampling Activities*.

5.7.8. Stabilization of field parameters is considered to be achieved when three consecutive readings are within the following limits and no increasing or decreasing trend in the data can be observed:

- Turbidity (10% for values less than 5 and greater than 1 NTU). It should be noted that achievements of turbidity levels less than 5 NTUs are not mandatory but efforts should be made to collect a groundwater samples with the lowest turbidity achievable
- DO (10% for values greater than 0.5 milligrams per liter (mg/L); if three dissolved oxygen values are less than 0.5 mg/L, consider the values as stabilized)
- Specific Conductance and Temperature (3%)
- pH (+/- 0.1 unit)
- ORP/Eh (+/- 10 millivolts)

5.7.9. If after 2 hours of purging the field parameters have not stabilized, purging may be discontinued to allow sample collection. Similarly, if it is not possible to obtain stabilization as described above as a result of slow recovery of the well, the well shall be evacuated and allowed to recover, at which point the samples should be collected immediately. The appropriate sampling forms shall include a notation that sample collection occurred without stabilization. Samples obtained from slow-yielding wells shall be collected as soon as a sufficient volume is available for a sample for each parameter.

5.7.10. Do **not** re-use purging equipment. Pumps shall be decontaminated between monitoring wells, in accordance with SOP 10065 *Decontamination of Field Sampling Equipment* or as otherwise specified in the site-specific Work Plan or Field Sampling Plan (FSP).

5.7.11. Any water purged from the monitoring wells shall be stored in appropriate waste containers.

5.8. Sample Withdrawal

5.8.1. In order to ensure that the groundwater sample is representative of the formation, it is important to minimize physical alteration (i.e. agitation during purging and/or sample collection) or chemical contamination of the sample during the withdrawal process.

5.8.2. Use an appropriate pump to purge each well; the same pump used for purging shall be used for sample withdrawal.

5.8.3. The samples shall be collected at a location before entering the flow-through cell. To minimize the effects of water column agitation on sample quality, samples shall be collected from the pump tubing in the following order into pre-labeled sample containers:

- VOCs
- Total petroleum hydrocarbons
- Extractable organics (semivolatiles)
- PCBs
- Metals
- Phenols
- Cyanide
- Chloride and sulfate
- Nitrate and ammonia
- Turbidity
- Radionuclides
- Purgeable organic carbon (POCs)
- Purgeable organic halogens (POX)
- Total organic halogens (TOX)
- Total organic carbon (TOC)

5.8.4. Samples shall be obtained from the monitoring wells as soon as possible after purging. This may require waiting an extended period for low-yielding wells.

5.8.5. Samples collected for VOC analysis shall be free of any air bubbles and inverted upon filling. Bacterial samples shall be collected using dedicated gloves; taking care not to allow anything to touch the inside of the sampling container.

5.8.6. Should samples collected for metals analysis need to be filtered, they must be done so in the field. Filter metals samples shall be passed through an appropriately sized filter prior to placement in the sample bottle. Pre-rinse the filter with approximately 25 to 50 milliliters of groundwater prior to collecting the samples for filtered metals analyses. Filter sizes will generally be either 10 microns for metals that could be present as colloids, or adsorbed onto colloids that could be mobile in the aquifer, or 0.45 microns for dissolved metals. The appropriate filter size for the individual project must be provided in site-specific Work Instructions.

5.8.7. After samples have been collected, secure the monitoring well.

5.9. "What If" Scenarios

5.9.1. Certain field conditions may be encountered that influence the choice of equipment to be used or altogether limit the feasibility of low-flow sampling techniques. The following is a brief description of select scenarios to provide field personnel with a guideline if similar circumstances are encountered.

5.9.2. Turbidity

If samples are being collected for analysis for total (unfiltered) metals and the turbidity has not stabilized below 10 NTU, a sample for additional analysis for metals should also be collected after being filtered in the field through an in-line 10-micron filter, if specified in the work instructions. Discard the first 500 milliliters of filtered groundwater sample to ensure the filter media has equilibrated to the sample.

5.9.3. Peristaltic Pump

5.9.3.1. Difficulty may be encountered while advancing the flexible polyethylene peristaltic pump tubing to the desired depth within a deep well or older well. Excessive friction may result from the tubing contacting the sidewall of the well casing or accumulations of material on the well casing (i.e., mineral and bacterial deposits). In these scenarios, the tubing may coil within the well during advancement and prevent the desired depth from being attained. Efforts to weight the tubing using inert materials should be attempted before using alternate pumping techniques.

5.9.3.2. If well conditions discussed in Section 5.9.3.1 are expected, a bladder pump or other submersible pump should be used instead of a peristaltic pump. A bladder pump provides sufficient mass on the tubing to allow for advancement in deep or older wells.

5.9.3.3. A peristaltic pump cannot be used to sample wells in which the depth to water is greater than approximately 25 to 30 feet.

5.9.4. Sampling Depth

If conditions exist that prevent the appropriate pump or tubing from being advanced to the midpoint of the saturated portion of the screened interval, low-flow sampling techniques shall not be used. Instead, sampling shall be conducted using conventional purging and sampling techniques, as described in SOP 10004 *Liquid Sample Collection and Field Analysis*. Justification for not using low-flow sampling techniques must be provided in the field paperwork.

5.10. Waste Management

Investigation derived wastes (IDW), including purge water, decontamination liquids, and disposable materials (PPE, plastic sheeting, etc.), will be placed in clearly labeled, appropriate containers in accordance with SOP 10059 *Management of Investigation Derived Waste*, or managed as otherwise specified in the site-specific Work Plan or FSP.

5.11. Documentation

Documentation of field activities will be completed in accordance with SOP 10038 *Documentation and Integrity of Field Sampling Activities.* In addition, field measurements will be recorded on the Low Flow Well Sample Record (attached). Any deviations from SOPs will be documented.

6. References

EPA. *Region I. Low Stress (Low Flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells,* September 19, 2017, Revision 4.

EPA. *Groundwater Sampling Guidelines for Superfund and RCRA Project Managers – Groundwater Forum Issue Paper, Office of Solid Waste and Emergency Response, (EPA 542-S-02-001),* May 2002.

Robert W. Puls and Michael Barcelona, EPA. *Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures, in Groundwater Issue, (EPA/540/S-95/504),* April 1996.

END OF DOCUMENT

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FIELD SAMPLING RECORD
LOW FLOW WELL SAMPLE

LEA Comm. No. **0000100.001** Page _____ of _____
Project Date ___/___/_____
Location LEA, Plainville, CT Sample Time ___:___
Client

Monitoring Well Number _____ Sample Number(s) _____ _____

Initial Field Data and Measurements

Depth of Well _____ Reference Used _____
Depth to Water _____ PID/FID Reading _____
Height of Column _____ Interface Yes / No If yes, Depth _____ Lighter / Heavier

Well Casing Diameter _____ Material _____
Protector Road Box / Stickup
Ground to Reference _____
Comments _____
_____

General Condition	OK	Bad
Casing Secure		
Collar Intact		
Cover Locked		
Other (describe)		

Development Information

Parameter / Time	Depth to Water	Pump Setting	Purge Rate (mL/min)	Cum. Liters Purged (L)	Temp (C)	Spec. Cond. (uS/cm)	pH (SU)	ORP (Eh)	DO (mg/L)	Turbidity (NTU)	Comment

Developement Method Peristaltic Pump / Bailer / Inertial Pump / Other _____

Sample Field Treatment *If any ambiguity could exist, be sure to indicate the field treatment applied to each sample aliquot with the appropriate suffix in the sample ID on both the sample bottle label and on the Chain of Custody!*

Field Decontamination? Yes / No If Yes, with what? _____
Waste Container ID _____

Additional Comments

Field Personnel _____ _____ ***Signature***
_____ _____ _____

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FIELD SAMPLING RECORD
LOW FLOW WELL SAMPLE

LEA Comm. No. **0000100.001** Page _____ of _____
Project Date ___/___/_____
Location LEA, Plainville, CT Sample Time ___:___
Client

Monitoring Well Number _____ Sample Number(s) _____ _____

Initial Field Data and Measurements

Depth of Well _____ Reference Used _____
Depth to Water _____ PID/FID Reading _____
Height of Column _____ Interface Yes / No If yes, Depth _____ Lighter / Heavier

Well Casing Diameter _____ Material _____
Protector Road Box / Stickup
Ground to Reference _____
Comments _____
_____

General Condition	OK	Bad
Casing Secure		
Collar Intact		
Cover Locked		
Other (describe)		

Development Information

Parameter / Time	Depth to Water	Pump Setting	Purge Rate (mL/min)	Cum. Liters Purged (L)	Temp (C)	Spec. Cond. (uS/cm)	pH (SU)	ORP (Eh)	DO (mg/L)	Turbidity (NTU)	Comment

Developement Method Peristaltic Pump / Bailer / Inertial Pump / Other _____

Sample Field Treatment *If any ambiguity could exist, be sure to indicate the field treatment applied to each sample aliquot with the appropriate suffix in the sample ID on both the sample bottle label and on the Chain of Custody!*

Field Decontamination? Yes / No If Yes, with what? _____
Waste Container ID _____

Additional Comments

Field Personnel _____ _____ ***Signature***
_____ _____ _____

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FIELD SAMPLING RECORD
LOW FLOW WELL SAMPLE

LEA Comm. No.	**0000100.001**	Page _____ of _____
Project		Date ___/___/_____
Location	LEA, Plainville, CT	Sample Time ___:___
Client		

Field Personnel	_____	_____	***Signature***
	_____	_____	_____

Loureiro Engineering Associates, Inc.
Standard Operating Procedure
for
Monitoring Well and
Piezometer Abandonment

SOP ID: 10041
Date Initiated: 08/13/02
Revision No. 001: 07/18/18

Revised By:	***/s/ Seth D. Travis***	***02/19/18***
	Seth D. Travis	**Date**
	Senior Geologist	
Reviewed By:	***/s/ Jo Ann Robertson***	***07/18/18***
	Jo Ann Robertson	**Date**
	Technical Associate	
Approved By:	***/s/ Karen Harris***	***07/18/18***
	Karen Harris	**Date**
	Quality Assurance Manager	

□ev □	Date	□dditions/Deletions/Modi□ications
□nitial □ssue	0□/□□/0□	
00□	0□/□□/□□	□evisions throughout□□ □dated to re□lect ne□ S□□ □ormat and incor□oration o□ne□ S□□s□□evised to include □ie□ometers□

Loureiro Engineering Associates, Inc.
Standard Operating Procedure
for
Monitoring Well and
Piezometer Abandonment

□□ Purpose and Scope

□he □ur□ose o□this standard o□erating □rocedure □S□□□is to outline the □rocedures that govern the abandonment o□ground□ater monitoring □ells□□ll abandoned ground□ater monitoring □ells shall be □ro□erly □lugged in order to sa□eguard □ublic health and hel□ mitigate the □otential □or sur□ace □ater in□iltration, circulation o□□ater bet□een □roducing □ones, or any other □rocess that could result in the contamination or □ollution o□ground□ater□□hroughout this S□□, re□erence to monitoring □ells also includes □ie□ometers unless s□eci□ically indicated other□ise□ □ell abandonment can also be com□leted in the □ollo□ing methods: □□ □er□orating the □ell casing □ollo□ed by grouting in □lace□□□grouting in □lace □ollo□ed by casing □ulling, and □□over□drilling and grouting □ith or □ithout tem□orary casing□□his S□□ includes only the □rocedure □or the abandonment o□monitoring □ells by grouting in □lace□Note that the abandonment o□ □ater su□□ly □ells are not covered by this S□□□

2. Related Standard Operating Procedures

- □00□□ □ Documentation and □ntegrity o□□ield Sam□ling □ctivities
- □00□□ □Management o□□nvestigation Derived □ astes
- □00□□ □Decontamination o□□ield Sam□ling E□ui□ment

□n addition to the above□noted S□□s, □ro□ect and client s□eci□ic re□uirements may be a□□licable to individual □ro□ects and should be discussed □ith the □ro□ect Manager and incor□orated into the □ro□ect s□eci□ic □or□□lan □□ or□□lan□□or adherence during the e□ecution o□the □ro□ect□

□□ Definitions

- □round□ater monitoring □ell: □ □ell designed and installed to obtain re□resentative ground□ater sam□les and hydrogeologic data□

- □ie□ometer: □ □ell designed and installed to obtain re□resentative hydrogeologic data□

- □ement□bentonite grout: □ mi□ture o□a□□ro□imately □□ □ounds o□□y□e □□ □ortland cement, a□□ro□imately □0 □ounds o□□o□dered sodium bentonite, and a□□ro□imately □0 gallons o□ □otable □ater □or a mi□ture o□the same ratio□□ □he bentonite must be

thoroughly mi□ed □ith the □ater be□ore the cement is added□□he cement bentonite grout shall have a density o□a□□ro□imately □□ □ounds/gallon□

- □remie □i□e: □ vertical or near vertical □i□e used to gravity □eed concrete belo□ a □ater table□

- □ ater su□□ly □ell: □ □ell, constructed □or the □ur□ose o□obtaining or □roviding □ater □or drin□ing or other domestic, industrial, commercial, agricultural, or recreational use□ Note that in the case o□□ater su□□ly □ells, a □ermit is re□uired □state□s□eci□ic□, and the abandonment must be a□□roved by the regional director o□ □ublic health □or other designated □arty □state□s□eci□ic□□□

□□ Equipment

□he □ollo□ing e□ui□ment and su□□lies shall be used during □ell abandonment activities, as re□uired:

- □ealth and sa□ety e□ui□ment □as re□uired by the site□s□eci□ic □ealth and Sa□ety □lan □□ □S□□□
- □hlorine solution
- □ atertight ca□
- □ement bentonite grout □□y□e □□□ortland cement, □o□dered sodium bentonite, □ater□
- □remie □i□e
- □rout □um□ □ith mechanical mi□ing ability
- □olyethylene □lastic sheeting
- Electronic □ater level indicator □accurate to 0□0□ □oot□
- □and tools □or accessing □ell
- □ra□□ic cones, caution ta□e or barrier
- □□ gallon drum and label

5. Procedures

□□□ □bandonment □rocedures shall be □er□ormed on all ground□ater monitoring □ells that are no longer being utili□ed to collect analytical or hydrogeological data or have been damaged□□□a damaged or unused □ell is encountered during the course o□normal □ield o□erations noti□y the □ro□ect manager□ □□on a□□roval, com□lete the □ell abandonment □rocedure□

□□□ Site □re□aration

□□□□□ □evie□ and □ollo□ the health and sa□ety □rocedures or re□uirements s□eci□ied in the site□s□eci□ic □□S□□ □ll □ersonal □rotective e□ui□ment □□□E□shall be donned as s□eci□ied in the site□s□eci□ic □□S□□

□□□□□ □ su□icient area shall be cordoned o□□using tra□ic cones, caution ta□e, or barriers to restrict access the □or□area□

□□□ E□ui□ment Decontamination and □leaning

□ll e□ui□ment □ill be decontaminated □rior to starting and in bet□een □ell abandonment activities in accordance □ith S□□ □00□□ *Decontamination of Field Sampling Equipment* or as other□ise s□eci□ied in the site□s□eci□ic □or□ □lan or □ield Sam□ling □lan □□S□□□

□□□ □he □rocedure □or the abandonment o□monitoring □ells is as □ollo□s:

□□□□□ □he □ell shall be □lugged to □revent the entrance o□ sur□ace □ater, circulation o□ □ater bet□een or among □roducing □ones, or any other □rocess resulting in the contamination or □ollution o□ ground□ater resources□

□□□□□□ □he □ell shall be chlorinated □rior to abandonment using a chlorine solution □ith a minimum concentration o□one hundred □i□ty □arts □er million □□□0 □□m□o□chlorine□□his is e□uivalent to □□□ □uarts o□bleach at □□□□□ available chlorine to □ive hundred □□00□gallons o□□ater or three hundred thirty□three □□□□□□eet o□□inch diameter □ell□□he need □or chlorination varies by state□□e□er to state guidance or □or□□lan□

□□□□□□ □he □ell shall be chec□ed □rom land sur□ace to the entire de□th o□the □ell be□ore it is sealed, to ensure against the □resence o□any obstruction that □ill inter□ere □ith sealing o□erations□

□□□□□□ □he □ell bore may be □illed and sealed □ith any o□the □ollo□ing material: heat cement grout, sand cement grout, bentonite clay grout, sand clay grout, or cement bentonite grout or similar material□□E□ ty□ically uses a cement bentonite grout as de□ined in this S□□□

□□□□□□ □he grout shall be slo□ly □oured into the monitoring □ell casing and □laced in such a □ay as to □revent voids in the casing or dilution o□the grout□

□□□□□□ □□ □arranted, the grout shall be □um□ed into the monitoring □ell to □revent voids in the grout or dilution o□the grout□ Since □um□ing e□ui□ment may be used else□here, all e□ui□ment, including the grout □um□ and tools must be thoroughly decontaminated □rior to the □ield activities and □rior to leaving the Site□Decontamination □rocedures are covered under S□□ □00□□ *Decontamination of Sampling Equipment.*

□□□□□□ □ ells constructed in a consolidated roc□ □ormation may be □illed □ith □ine sand in the □one or □ones o□consolidated roc□□□he to□ o□the sand □ill shall be at least ten □□0□□eet belo□ the bottom o□the casing□

□□□□□□ □ny test □ell or boring shall be abandoned in such a manner that it does not become a channel □or the vertical movement o□ □ater or other substances to □otable ground□ater resources□

□□□□□□ □□on com□letion o□abandonment o□the □ell, the to□ o□the casing or grout material shall be terminated at least □ □eet belo□ the ground sur□ace□

□□□ □ aste Management

□nvestigation derived □astes □□D□ □, including decontamination li□uids and dis□osable materials □□□E, □lastic sheeting, etc□□□ill be □laced in clearly labeled, a□□ro□riate containers in accordance □ith S□□ □00□□*Management of Investigation Derived Waste*, or managed as other□ise s□eci□ied in the site s□eci□ic □ or□ □lan or □S□□Dis□laced □ater □ill be managed as s□eci□ied in the site s□eci□ic □ or□ □lan or □S□□

6. □e□erences

□□□□□*Description of Organization, Rules of Practice and Regulations for the Well Drilling Industry* □□ □□□□□□□□□□ □□□□□□□□□□, □onnecticut De□artment o□□onsumer □rotection, March □0□□□

E□□□ *Handbook of Suggested Practices for the Design and Installation of Groundwater Monitoring Wells*, E□□ □□00□□□□□□0□□, □nited States Environmental □rotection □gency □E□□□, March □□□□□

N□DE□□ □□□□□: *Groundwater Monitoring Well Decommissioning Policy*, Ne□ □or□ State De□artment o□Environmental □onservation □N□SDE□□, November □, □00□□

□□□□DEM□*Groundwater Quality Rules (Appendix 1 – Construction Standards for Monitoring Wells and Abandonment Procedures for Monitoring Wells, Piezometers, and Other Subsurface Borings)*, State o□ □hode □sland and □rovidence □lantations De□artment o□ Environmental Management, March □0□0□

□S□M *ASTM D-5299/D-5299M-17: Standard Guide for Decommissioning of Groundwater Wells, Vadose Zone Monitoring Devices, Boreholes, and Other Devices for Environmental Activities*, □S□M □nternational, □0□□□

END □□D□□□MEN□

Loureiro Engineering Associates, Inc.
Standard Operating Procedure
for
Collecting and Preserving Soil and Sediment Samples for Laboratory Determination of Volatile Organic Compounds

SOP ID: 10057
Date Initiated: 03/01/06
Revision No. 002: 07/23/18

Revised By:	***/s/Karen Goldenberg***	***04/01/18***
	Karen Goldenberg	**Date**
	Senior Technical Associate	
Reviewed By:	***/s/Jo Ann Robertson***	***07/19/18***
	Jo Ann Robertson	**Date**
	Technical Associate	
Approved By:	***/s/Karen Harris***	***07/23/18***
	Karen L. Harris	**Date**
	Quality Assurance Manager	

REVISION RECORD

Rev #	Date	Additions/Deletions/Modifications
Initial Issue	03/01/06	
001	04/01/12	Removed ‘Draft’ designation.
002	07/23/18	Updated format, minor edits throughout.

Loureiro Engineering Associates, Inc.
Standard Operating Procedure
for
Collecting and Preserving Soil and Sediment Samples for Laboratory Determination of Volatile Organic Compounds

1. Purpose and Scope

Volatile organic compounds (VOCs) are lost from soil and sediment samples (hereinafter referred to as soil samples) due to volatilization and biodegradation during collection, storage, and analysis. This leads to low-biased results. Some commonly used sampling techniques are prone to relatively large losses and results that are potentially biased quite low. Such techniques involve collection of disturbed soil samples and storage in soil jars without air-tight seals. This standard operating procedure (SOP) describes soil sample collection and preservation techniques designed to minimize such losses. The procedure below has been adapted from EPA Method 3035A.

2. Related Standard Operating Procedures

- 10005 – Quality Assurance/Quality Control Measures for Field Sampling Activities
- 10006 – Soil Sampling
- 10015 – Geologic Logging of Unconsolidated Sedimentary Deposits
- 10038 – Documentation and Integrity of Field Sampling Activities
- 10059 – Management of Investigation Derived Waste
- 10065 – Decontamination of Field Sampling Equipment
- 10067 – Handling, Packaging, and Shipping of Analytical Samples

3. Definitions

- EnCore® Sampler: a disposable volumetric sampling device designed to assist field personnel in taking soil samples with minimal handling and maximum accuracy.
- Low Concentration Soil Samples: the specific concentration may vary between laboratories, but generally "low" refers to a concentration below approximately 200 micrograms per kilogram (µg/kg).
- High Concentration Soil Samples: the specific concentration may vary between laboratories, but generally "high" refers to any concentration greater than 200 µg/kg.
- Undisturbed samples: those for which the sampling device minimizes break-up of the structure of the soil to the extent practicable. Undisturbed samples can be collected using such techniques as:

- Coring, such as the methods utilizing split-spoon sampling devices, MacroCores ™, and large-bore direct-push samplers;
- Bulk sampling, for example, undisturbed soil volumes collected using a backhoe bucket from sidewalls of trenches and excavations where direct access to the sampling location (sidewall or bottom) is not safe; and
- Direct collection of sub-samples from the subsurface.

- Sub-samples: those samples that are submitted to the laboratory for analysis for VOCs.

4. Equipment

- Health and safety equipment (as required by the site-specific Health and Safety Plan [HASP])
- Photoionization Detector (PID) and calibration kit
- Electronic field balance accurate to 0.1 grams
- Sample labels and custody seals
- Re-sealable plastic bags
- Utility knife
- Stainless steel spatula or trowel
- Decontamination fluids
- Paper towels
- Magnetic stir bar
- Cooler and ice
- Syringe (if needed)
- Water (if needed)
- Methanol (if needed)
- Sodium bisulfate solution (if needed)
- Volatile Organic Analysis (VOA) vials (40 ml) (if needed)
- 20 gram sample container for percent solids (a different size container may also be suitable) (if needed)
- EnCore®-type Sampler (5, 10 and 25 gram samplers) and T-handle (if needed)

4.1. Site Preparation

- A level table shall be placed within the exclusion zone and covered with polyethylene sheeting.

- Decontaminated spatulas shall be placed on the table. Sample bottles and EnCore®-type sampler with T-handle shall be placed in a convenient location and in order of sample collection.

- PID and plastic bags shall be placed on the table for VOC field screening, if necessary.

4.2. Cleaning and Decontamination

Prior to and following collection of soils sample, ensure that all sampling equipment is cleaned and decontaminated in accordance with SOP 10065 *Decontamination and Integrity of Field Sampling Equipment.*

4.3. Personal Protective Equipment

All personal protective equipment (PPE) should be donned and maintained in accordance with the site-specific work plan or health and safety plan during all sampling procedures.

4.4. Overview of Sampling Approach

The soil sample collection procedure for determination of VOCs is a two-step process:

Step 1 – Collect an undisturbed soil sample, as defined below, from the subsurface, or expose the targeted area from where a sub-sample for laboratory analysis will be collected.

Step 2 – Collect a representative sub-sample from the undisturbed sample or directly from the exposed subsurface.

4.5. Collection of Undisturbed Samples

When collecting samples for laboratory determination of VOCs, the device used to collect the undisturbed soil sample shall be removed as soon as possible from the subsurface; and most importantly, **the sub-samples that are intended for VOC determination must be collected as soon as possible (ideally within five minutes of collection of the undisturbed sample) to reduce loss of VOCs due to volatilization.** Attempts must be made to further minimize loss of VOCs by managing the sample collection environment (i.e. limiting sun, wind, heat, etc.).

Planning and careful preparation are critical for a successful sampling event. Checklists should be used to ensure that all necessary equipment and supplies are present and in proper working order and that the following conditions are achieved:

- Undisturbed soil to be collected for sub-sampling should be collected in a manner that controls the procurement of the samples such that they do not "stack up" awaiting logging and sub-sampling;
- Cores should not be stored in small- or large-diameter sampling devices or capped liners (brass, acetate, lexan, polycarbonate, etc.);
- Cores should not be exposed to extreme weather conditions, such as direct sunlight, rain and wind, and sub-sample collection should occur in an area that minimizes exposure to the elements (e.g., under cover, shady areas); and
- Undisturbed soil samples cannot be transferred from the core sampler to a secondary container (empty sample bottle, re-sealable bag, aluminum foil, or sampling bowls) for future sample collection.

Leaving samples in core tubes, split-spoons, covered liners, or intermediate containers will lead to VOC losses and will thus yield poor quality data. If a backlog develops, request the sample collection/drilling crew to slow down.

To the extent practicable, undisturbed samples should always be collected. However, under no circumstances should a sub-sample be collected from a disturbed sample that was previously used for field-screening purposes.

4.6. Collection of the Soil Sub-Sample for Determination of VOCs

Sub-samples are those samples that are submitted to the laboratory for analysis for VOCs. Sub-sampling of the undisturbed soil sample must be performed using a dedicated or decontaminated small-diameter sampler. Sub-samples must be collected as soon as possible from the undisturbed sample (ideally within five minutes) after the undisturbed soil sample is collected.

5. Overview of Sub-Sampling Devices

Sub-sampling of the large-diameter or bulk sampling device for VOCs must be performed with the use of a dedicated or decontaminated small-diameter core sampler. The small-diameter core sampler should fit inside the mouth of the sample container to avoid loss of sample, prevent damage to the sealing surfaces or container threads, and ease the soil transfer process.

The small-diameter core sampler must be constructed with non-reactive materials that will not sorb VOCs (stainless steel, brass, glass, polytetrafluoroethylene (PTFE), and some rigid plastics).

5.1. Procedure for Obtaining Test Samples to Determine Sub-Sample Volume

The purge and trap laboratory procedure used to determine VOCs requires approximately equal amounts of soil and liquid to be used in the analysis. If the ratio of soil to liquid is too high, the soil will not be adequately dispersed in the liquid, leading to poor results. If the amount of soil is too low, the detection limits will be increased, potentially rendering the results to be of limited use. It is better to use a slightly lower weight of soil than a higher weight, as the regulatory limits are, in general, significantly higher than the typical laboratory reporting limit for volatile analytes.

The small-diameter core sampler must be able to deliver a minimum of 5 grams of sample (≈ 3 cm^3 of sample, assuming a density of 1.7 g/cm^3) into a 40-ml VOA vial. While most small-diameter core samplers can only be used for sampling and placement into the appropriate sample containers, only the EnCore® -type samplers can be used for sampling, storage, and transportation of the sample to the laboratory.

It is important that the small-diameter core sampler provide the required mass of sample material. As such, a test sample (of similar matrix to that being sampled) may be collected and weighed to determine the amount of soil needed to obtain the required mass of sample material for each type of small-diameter core sampler and analytical method.

5.1.1. The procedure for obtaining a test sample is as follows:

5.1.1.1. Using a small electronic portable scale with an accuracy of 0.1 grams, weigh the empty small-diameter core sampler (e.g., disposable syringe) to the nearest 0.1 grams. The scale must be calibrated before use and intermittently checked during the day to ensure accurate weight measurement. Calibration information must be recorded in the field logbook. A translucent cover can be placed over the scale during the weighing process to negate variations caused by wind.

5.1.1.2. Push the small-diameter core sampler test sample into the matrix to collect the required mass of material (3 cm^3 should yield approximately 5 grams of sample [wet weight]).

5.1.1.3. Wipe clean any soil adhering to the outside of the small-diameter core sampler before weighing.

5.1.1.4. If the weight is above the required amount, remove excessive soil by extruding a small portion of the core and cutting it away with a decontaminated trowel or spatula. If the weight is below the weight limit, obtain additional soil by reinserting the small-diameter core sampler into the soil core. Re-weigh after each addition or removal of sample from the small-diameter core sampler until the target weight is attained. Note the sample volume and amount in the small-diameter core sampler.

5.1.1.5. Discard the test sample appropriately.

5.1.1.6. Use the volume of the test sample as a guide in collecting the appropriately sized sub-sample of a similar matrix. **Additional test samples should be weighed whenever a change in the matrix is observed.**

5.2. Overview of Procedure for Collection of Sub-Samples

The goal of soil sampling for the purposes of evaluating concentrations of contaminants in soil is to obtain a representative soil sample in accordance with the data quality objectives for the project. Often, this is accomplished using an appropriate small-diameter core sampler.

Different sample matrices (e.g., sand, gravel, clay, fill) will be encountered and may warrant slightly different sub-sampling field techniques. The goal for all techniques is to collect the sub-sample as quickly as possible while minimizing disruption. Environmental professionals should use good judgment as to how to handle samples that do not fit into the samplers and must describe the rationale for any deviations from this guidance.

The procedure for obtaining soil sub-samples is as follows:

5.2.1. Once the sampling interval has been selected, trim off the exposed surface of the matrix to expose a fresh surface. A loss of VOCs from the surface of the matrix will occur even if the matrix has been exposed for a short period of time (during screening, etc.). Removal of the unwanted surficial material can be accomplished by scraping the matrix surface with a decontaminated spatula or trowel. Soil sampling must commence immediately once a fresh surface has been exposed.

5.2.2. If hand augering, collect the sub-sample directly from the bottom of the hand auger immediately after pulling it from the ground. Do not attempt to remove the soil from the hand auger first.

5.2.3. Using the test sample as a guide, push the small-diameter core sampler into the matrix to collect a volume of material that will yield the required mass of sample (wet weight) as determined by the analytical method.

5.2.4. Depending upon the texture, depth or moisture content, insert the small-diameter core sampler straight into the matrix, on an angle. Multiple insertions can be made to obtain the required sample weight.

5.2.5. After sample collection, wipe the outside of the small-diameter core sampler to remove any excess material adhering to the barrel.

5.2.6. Immediately open the sample container and extrude the soil core into the sample container that will be submitted to the laboratory. Avoid splashing any preservative, if present, out of the sample container by holding the container at an angle while slowly extruding the soil core into the sample container. Do not immerse the small-diameter core sampler into the preservative. If an EnCore®-type sampler is to be used for storage and shipment, prepare the sampler for shipment according to manufacturer's instructions.

5.2.7. Collect the required number of sample containers or EnCore® -type samplers based on the chosen preservation and analytical methods, as discussed in the subsequent section on soil preservation methods.

5.2.8. Include an additional sample for determination of soil moisture content and sample screening.

5.2.9. Ensure the threads and cap of the sample container or EnCore®-type sampler are free of soil particles. Use a clean paper towel to remove soil particles from the threads and sealing surface of the sample container or EnCore® -type sampler. The presence of soil particles will compromise the container's seal and may result in loss of preservative or VOCs. This loss ultimately may invalidate the sample analysis. Always make sure the sample lid is firmly secure.

5.2.10. Record the laboratory and field identification numbers in the field notes and on the chain of custody in accordance with SOPs 10038 *Documentation of Field Sampling Activities* and 10067 *Handling, Packaging, and Shipping of Analytical Samples.*

5.2.11. After sample collection, immediately return the containers to an iced cooler. Sample containers from different locations should be placed in separate re-sealable bags to help avoid cross-contamination. The

laboratory sample number or field sample identification number may be placed on the bag and cross-referenced on the chain of custody. The laboratory performing the analysis will determine the sample weight.

6. Preservation of the Soil Sample

6.1. Overview of the Soil Preservation Procedure

Samples must be physically preserved (e.g. iced or frozen) in the field immediately upon sample collection. It is important to match up the correct physical preservation method with the appropriate sample container and field chemical preservation method. According to the United States Environmental Protection Agency (EPA) Contract Laboratory Protocol (CLP) Guidance for Field Samplers, the physical preservation methods are described as:

Iced – soil and sample containers are cooled to 4º ± 2ºC.
Frozen – soil and sample containers are cooled to between -11º ± 4º C.

Sample containers that will be frozen should be placed on their side prior to freezing process to prevent breakage. Additional aliquots for screening and moisture determination need only be iced and kept cooled at 4º ± 2ºC; these sample containers should not be frozen. ***Sample containers and EnCore®-type samplers should not be frozen below -20º C, as the integrity of the container seals, o-rings and septum may be compromised by the freezing, resulting in the loss of VOCs upon thawing of the sample.***

In addition, the use of dry ice to freeze samples immediately upon sample collection or for use during shipment is not recommended. Dry ice, which is at a temperature of -78.5 ºC, will lower the temperature of the sample container below the design specifications, causing damage to the glass, septum, seals, o-rings, and cap. In addition, dry ice has specific handling, storage and shipping requirements that outweigh its usefulness to the field sampling team.

6.2. Sub-Soil Sample Collection Procedures

When collecting soil sub-samples for determination of volatile organic compounds, up to four types of samples may be required:

- A high-concentration-level sample (two options)
- A low-concentration-level sample (four options)
- An Synthetic Precipitation Leaching Procedure (SPLP)/Toxicity Characteristic Leaching Procedure (TCLP) sample

- A sample for percent solids determination

When the expected VOC concentrations are not known, it is recommended to collect both the high- and low-concentration samples. The analysis procedure should be coordinated with the laboratory. For example, one approach would be to analyze one first (and if needed, the second one).

Additional samples may be necessary for matrix spikes and matrix spike duplicates. Field and trip blanks also may be required.

An overview of the various options for sample collection procedures is attached as Figure 1.

6.3. High-Concentration Sub-sample Collection Procedures

There are two options for collection of the high-concentrations sample: collection of the sample in a methanol preserved VOA vial or using EnCore®-type samplers.

6.3.1. OPTION 1 – High Concentration Sample, Methanol Preservation

Supplies:

- Electronic field balance accurate to 0.1 grams
- Minimum of one VOA vial (40 ml), pre-weighed and containing 5 or 10 ml of methanol
- Sub-sampling device

6.3.1.1. Label the vials as appropriate. Do not add excessive labels (e.g. more weight) to the pre-weighed vials.

6.3.1.2. Weigh the vials to confirm the recorded vial weight.

6.3.1.3. Select the area to be sampled as soon as possible after the soil is exposed.

6.3.1.4. Obtain a test sample, using the coring device and field balance, to determine approximately how much volume of soil will yield equal grams of soil to methanol (5 or 10 ± 1 grams). This step may be skipped when the amount of soil needed for a particular matrix at a site has been determined.

6.3.1.5. Scrape away the surface material from the area to be sampled using a clean/decontaminated spatula or trowl to expose fresh soil.

6.3.1.6. Rapidly insert the syringe into the soil to obtain the sample. Quickly extrude the sample into the vial containing the methanol. Wipe off the threads and cap using a paper towel; seal the vial.

6.3.1.7. Using the field balance, weigh and record the weight of the vial in the field notes.

6.3.1.8. Place sample in cooler with ice.

6.3.1.9. Collect separate sample for percent solids, if necessary.

6.3.2. OPTION 2 - High-Concentration Sample, Using EnCore®-Type Samplers

Supplies: One 5 or 10-gram EnCore®-type Sampler

6.3.2.1. Label the re-sealable pouch as appropriate.

6.3.2.2. Select the area to be sampled as soon as possible after the soil is exposed.

6.3.2.3. Scrape away the surface material from the area to be sampled using a clean/decontaminated spatula or trowel to expose fresh soil.

6.3.2.4. Rapidly insert the sampler into the soil to obtain the sample. Quickly wipe the contact areas using a paper towel to remove any soil particles, close and seal the device.

6.3.2.5. Place devices in re-sealable pouch, place in cooler on ice.

6.3.2.6. Collect separate sample for percent solids, if necessary.

6.3.2.7. Samples must be frozen, preserved, or analyzed within 48 hours of collection.

6.4. Low-Concentration Sub-Sample Collection Procedures

There are four options for collecting low-concentration soil samples:

- Collection in VOA vials containing water
- Collection in empty VOA vials

- Collection in VOA vials containing sodium bisulfate
- Collection using EnCore®-type devices

All of the procedures using VOA vials are essentially the same, except for the media contained in the vial. It should be noted that sodium bisulfate preservation might lead to formation of acetone in samples containing high amount of humic material. Additionally, certain analytes, such as styrene, vinyl chloride, trichloroethylene (TCE), may be decomposed by the bisulfate, leading to low-biased results. Also carbonate-rich soils may effervesce. The effervescing will result in significant losses of VOCs, and in such cases the sodium bisulfate cannot be used. Environmental professionals should use caution in using this preservation technique. **For these reasons, it is recommended that another one of the other low-level preservation options be used. If the sodium bisulfate preservation option is used, the data should be considered in relation to the conceptual site model.**

6.4.1. OPTION 1 - Low-Concentration Sample, Using VOA Vials Containing Water

Supplies:

- Electronic field balance accurate to 0.1 grams
- 2 VOA vials (40 ml), pre-weighed, containing 5 ml of water and a magnetic stir bar
- Sub-sampling device

6.4.1.1. Label the vials as appropriate. Do not add excessive labels or tape over the label (e.g. more weight) to the pre-weighed vials.

6.4.1.2. Select the area to be sampled as soon as possible after the soil is exposed.

6.4.1.3. Obtain a test sample, using the coring device and field balance, to determine approximately how much volume of soil will yield 5 grams of soil. Note that the sample weight should be within 1 gram of the nominal weight, e.g. 5± 1 gram. This step may be skipped when the amount of soil needed for a particular matrix at a site has been determined.

6.4.1.4. Scrape away the surface material from the area to be sampled using a trowel or spatula to expose fresh soil.

6.4.1.5. Rapidly insert the syringe into the soil to obtain the first 5-gram sample. Quickly extrude the sample into one of the two vials containing the water. Wipe off the threads and cap using paper towels; seal the vial.

6.4.1.6. Repeat steps 6.4.1.4 and 6.4.1.5 for the second vial containing water.

6.4.1.7. Using the field balance, weigh and record the weight of each vial in the field notes.

6.4.1.8. Place all samples in cooler with ice.

6.4.1.9. Collect separate sample for percent solids, if necessary.

6.4.1.10. Samples must be frozen or analyzed within 48 hours of collection.

6.4.2. OPTION 2 - Low-Concentration Sample, Collection in Empty VOA Vials

Supplies:

- Electronic field balance accurate to 0.1 grams
- 2 VOA vials (40 ml), pre-weighed containing a magnetic stir bar
- Sub-sampling device

6.4.2.1. Label the vials as appropriate. Do not add excessive labels or tape over the label (e.g. more weight) to the pre-weighed vials.

6.4.2.2. Select the area to be sampled as soon as possible after the soil is exposed.

6.4.2.3. Obtain a test sample using the coring device and field balance, to determine approximately how much volume of soil will yield 5 grams of soil. Note that the sample weight should be within 1 gram of the nominal weight, e.g. 5± 1 gram. This step may be skipped when the amount of soil needed for a particular matrix at a site has been determined.

6.4.2.4. Scrape away the surface material from the area to be sampled using a spatula or trowel to expose fresh soil.

6.4.2.5. Rapidly insert the syringe into the soil to obtain the first 5-gram sample. Quickly extrude the sample into one of the two vials. Wipe off the threads and cap using paper towels; seal the vial.

6.4.2.6. Repeat steps 6.4.2.4 and 6.4.2.5 for the second vial.

6.4.2.7. Using the field balance, weigh and record the weight of each vial. A record of the weight must be submitted with the samples to the laboratory.

6.4.2.8. Place all samples in cooler with ice.

6.4.2.9. Collect separate sample for percent solids, if necessary.

6.4.2.10. Samples must be frozen or analyzed within 48 hours of collection.

6.4.3. OPTION 3: Low-Concentration Sample, Collection in VOA Vials Containing Sodium Bisulfate

Supplies:

- Electronic field balance accurate to 0.1 grams.
- 2 VOA vials (40 ml), pre-weighed containing 5 ml sodium bisulfate solution and a magnetic stir bar.
- Sub-sampling device.

6.4.3.1. Label the vials as appropriate. Do not add excessive labels or tape over the label (e.g. more weight) to the pre-weighed vials.

6.4.3.2. Select the area to be sampled as soon as possible after the soil is exposed.

6.4.3.3. Obtain a test sample using the coring device and field balance to determine approximately how much volume of soil will yield 5 grams of soil. Note that the sample weight should be within 1 gram of the nominal weight, e.g. 5 ± 1 gram. This step may be skipped when the amount of soil needed for a particular matrix at a site has been determined.

6.4.3.4. Scrape away the surface material from the area to be sampled using a spatula or trowel to expose fresh soil.

6.4.3.5. Rapidly insert the syringe into the soil to obtain the first 5-gram sample. Quickly extrude the sample into one of the two vials

containing the bisulfate solution. Wipe off the threads and cap using a paper towel; seal the vial.

6.4.3.6. Repeat steps 6.4.3.4 and 6.4.3.5 for the second vial.

6.4.3.7. Using the field balance, weigh and record the weight of each vial and record in the field notes.

6.4.3.8. Place all samples in cooler with ice.

6.4.3.9. Collect separate sample for percent solids, if necessary.

6.4.4. **OPTION 4 - Low-Concentration Sample, Collection Using EnCore®-Type Devices**

Supplies: Two 5-gram EnCore®-type sampling devices

6.4.4.1. Label the re-sealable pouch as appropriate.

6.4.4.2. Select the area to be sampled as soon as possible after the soil is exposed.

6.4.4.3. Scrape away the surface material from the area to be sampled using a spatula or trowel to expose fresh soil.

6.4.4.4. Rapidly insert the sampler into the soil to obtain the first sample. Quickly wipe the contact areas to remove any soil particles using a paper towel, close and seal the device. Place device in re-sealable pouch

6.4.4.5. Repeat steps 6.4.4.3 and 6.4.4.4 for the second EnCore®-type device.

6.4.4.6. Place both devices in re-sealable pouches, place in cooler on ice.

6.4.4.7. Collect separate sample for percent solids, if necessary.

6.4.4.8. Samples must be frozen, preserved or analyzed within 48 hours of collection.

6.5. Collection of Soil Samples for TCLP or SPLP Volatile Organic Analysis

The holding time for soil samples to begin the leaching procedure for TCLP or SPLP extraction for VOC analysis is 14 days from collection. If the environmental professional requests the laboratory to hold the samples until the results of the total (e.g., mass) analysis for VOCs is available, the total analysis must be available within a time-frame that will permit the environmental professional to give the laboratory sufficient notice to be able to start the SPLP/TCLP leaching within the 14-day holding time.

Supplies: 25-gram EnCore®-Type Sampler

6.5.1. Label the re-sealable pouch as appropriate.

6.5.2. Select the area to be sampled as soon as possible after the soil is exposed.

6.5.3. Scrape away the surface material from the area to be sampled using a spatula or trowel to expose fresh soil.

6.5.4. Rapidly insert the sampler into the soil to obtain the sample. Wipe off the threads and cap using paper towels; seal the sampler.

6.5.5. Place sampler in re-sealable pouch and place in cooler with ice.

6.5.6. Samples must be frozen or leached within 48 hours of collection.

6.6. Collection of Soil Samples for Percent Solids Determination

A laboratory typically can use any container submitted for analysis to determine the percent solids of a soil, **except a container submitted for VOC analysis.** If the other laboratory analyses, besides VOCs (either total or TCLP/SPLP volatiles), are to be performed on soil for a given sampling interval and location, a separate container(s) will be needed for the other tests. The percent solids determination can then be performed using the soil in the container(s) for the other tests. In the event that only VOCs are to be determined for a given soil sample, the environmental professional must collect additional sample (no more than 20 grams would be needed) in a separate container for submittal to the laboratory. Typically, a small plastic container would suffice, although any container would do.

7. Documentation

Documentation of field activities will be completed in accordance with SOP 10038 *Documentation and Integrity of Field Sampling Activities*.

8. References

EPA. *EPA Method 5035A Closed-System purge-and-trap and extraction for Volatile Organics in Soil and Waste Samples.* Draft Revision 1, July 2002.

EPA. *Behavior and Determination of Volatile Organic Compounds in Soil*, EPA/600/R-93/140, May 1993.

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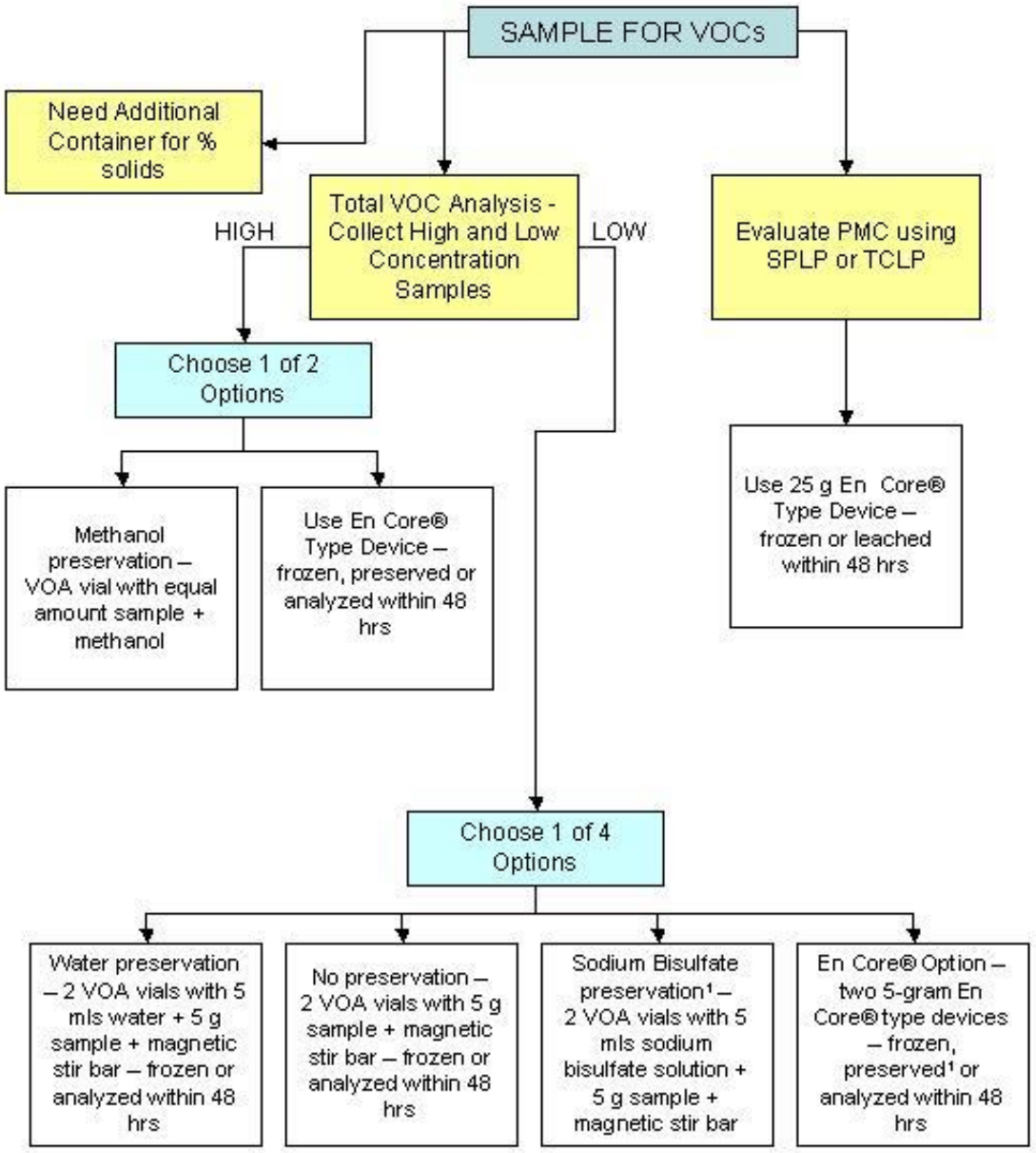
Hewitt, A.D. and Lukash, N., USACE. *Obtaining and Transferring Soils for In-Vial Analysis of Volatile Organic Compounds,* USACE Special Report 96-5, February 1996.

USACE. *Sample Collection and Preparation Strategies for Volatile Organic Compounds in Solids* (October 1998). http://clu-in.org/download/stats/sampling. pdf.

Hewitt, A.D., USACE. *Preparing Soil Samples for Volatile Organic Compound Analysis*, USACE Special Report 97-11, April 1997.

Hewitt, A.D., USACE. *Storage and Preservation of Soil Samples for Volatile Organic Compound Analysis*, USACE Special Report 99-5, May 1999.

Figure 1 – Sample Collection Flow Chart



Note: Not appropriate for all circumstances – see Section 6.4 of this document.

Loureiro Engineering Associates, Inc.
Standard Operating Procedure
for
Management
of
Investigation Derived Waste

SOP ID: 10059
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Revision No. 001: 07/18/18

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Quality Assurance Manager

REVISION RECORD

Rev#	Date	Additions/Deletions/Modifications
Initial Issue	03/04/09	
001	07/18/18	Add types if IDW, modify definitions

Loureiro Engineering Associates, Inc.
Standard Operating Procedure
for
Management
of
Investigation Derived Waste

1. Purpose and Scope

During field investigation activities, there are various investigation derived wastes (IDW) generated by day-to-day operations that may pose a risk to human health and the environment. These materials are typically stored in containers (portable devices including, but not limited to, 55-gallon drums, cubic yard boxes, roll-off containers, etc.) temporarily and managed by the client/property owner prior to off-site disposal. The management of IDW at Loureiro Engineering Associates, Inc. (LEA) client sites must be performed in such a way as to ensure the protection of human health and the environment and must comply with applicable regulatory requirements.

2. Related Standard Operating Procedures

- None

While no related SOPs are referenced in this document, project and client-specific requirements may be applicable to individual projects and should be discussed with the Project Manager and incorporated into the project-specific documents work plan (Work Plan) for adherence during the execution of the project.

3. Definitions

- IDW: wastes generated during the normal course of environmental site investigations. Types of IDW include:
    - Personal protective equipment (PPE) - This includes disposable coveralls, gloves, booties, respirator canisters, splash suits, etc.
    - Disposable equipment and items - This includes plastic ground and equipment covers, aluminum foil, conduit pipe, composite liquid waste samplers (COLIWASAs), Teflon® tubing, broken or unused sample containers, sample container boxes, tape, etc.
    - Soil cuttings – soil generated from drilling or hand augering

  - Drilling mud - mud and/or water generated during mud or water rotary drilling
  - Groundwater – groundwater purged from well
  - Cleaning fluids – Fluids used in decontamination of equipment, including spent solvents and wash water
  - Packing and shipping materials

- Temporary storage: Temporary storage is defined as the holding of waste materials for a temporary period, at the end of which the waste material is treated, disposed of, or stored elsewhere.

- Container: A container is a portable device in which a material is stored, transported, treated, disposed of, or otherwise handled.

- Containerized Waste: Solids, liquids or sludges that are found in drums, bulk storage tanks, transformer or lab packs

- Un-containerized Waste: Solids, liquids or sludges that are found in indoor or outdoor waste piles and surface impoundments.

- Large Quantity Generators (LQGs): The generation of 1,000 kg or more per month of hazardous waste or more than 1 kg per month of acutely hazardous waste. See 40 CFR part 262 for a complete description of LQG regulations.

- Small Quantity Generators (SQGs): The generation of 100 kg, but less than 1000kg of hazardous waste per month. See 40 CFR part 262 for a complete description of SQG regulations.

4. Equipment

The following equipment and supplies shall be used while managing Investigation Derived Waste, as required:

- Health and safety equipment (as required by the site-specific Health and Safety Plan [HASP])
- Containers (open-top & closed-top drums, cubic yard boxes, totes, roll-offs, etc.)
- Containment pallets
- Wood pallets
- Polyethylene plastic sheeting
- Adhesive labels
- Clear tape
- Indelible markers
- Paint stick

- Hand tools for opening drums

5. Procedure

5.1. Pre-job communications

5.1.1. The project manager or designee shall communicate with the assigned field personnel the management methods for IDW generated at the site. Based on the planned scope of work, ensure the appropriate number and types of containers are available for the volume and types of IDW generated.

5.1.2. Clearly identify how the naming convention for IDW containers at the site will be done to facilitate identification at time of disposal. LEA provides containers and assigns a unique container designation that consists of the following information, each separated by a dash:

- A two-letter site identifier (e.g., XY-)
- A two-digit container type identifier (e.g., OT-)
- A three-digit container identifier (e.g., 001)

Using the above information, the resulting container designation is XY-OT-001.

Container type identifiers are as follows:

OT – Open Top Drum
CT – Closed Top Drum
RO – Roll-Off
CY – Cubic Yard Box
5G – 5 Gallon Pail
PT – Portable Tank/Tote

Note: some clients/sites issue containers with existing container identifications (IDs) and labels, however, this is not typical.

5.1.3. Based on Resource Conservation and Recovery Act (RCRA) regulations, a site may be limited in the number of hazardous waste containers on a site at any given time (i.e., small quantity generators and conditionally exempt small quantity generators). If it is known or presumed that the IDW generated meets the definition of a hazardous waste, the project manager or designee shall communicate with the assigned field personnel the maximum amount of waste that may be generated at the site prior to IDW characterization.

5.2. Safety

Proper safety precautions must be followed during the management and handling of IDW. Review and follow the health and safety procedures or requirements, including movement of containers and chemical safety, specified in the site-specific HASP. All necessary personal protective equipment (PPE) shall be donned as specified in the site-specific HASP.

5.3. Temporary storage area location:

5.3.1. The location chosen for the temporary storage of IDW must be determined in advance and approved by the project manager or client. At locations where the client may not be the property owner, a location must be approved by the operating facility manager to ensure that they have knowledge of the material in case of an emergency condition (fire, flood, storm, etc.) and that the storage/location of the containers does not interfere with daily operations.

5.3.2. The location of the temporary storage area should be level and stable in order to prevent containers from shifting/tipping.

5.3.3. The location chosen should be readily accessible for waste vendors and transportation vehicles at the time of off-site disposal. Containers should not be located in areas which are not accessible for their removal.

5.4. Container Identification

5.4.1. Clearly identify each container with a unique container identification number and record information on daily field sheet. Write generator site name/address and a description of the waste along with the accumulation date on adhesive label and attach to the side of the container. The container markings should also include the words "investigationderived waste pending determination" and the container designation. The markings and labels should be covered with clear tape to prevent wash off and fading. A sample label is provided below. **Note:** once a container is full the word "full" should be marked on the container so that no additional material is added.

XYZ Corporation
10 Main Street
Somewhere, CT 00000

Investigation Derived Waste Pending Determination

(Soil Cuttings, Disposable sampling equipment)

XY-OT-001
Accumulation Start Date: 02/27/2018

Due to the time limitations and restrictions posed by RCRA regulations on storage of hazardous waste, accumulation dates should be identified on all containers of IDW so that they can be managed in a timely manner. Note that the RCRA regulations on number of days in storage starts when waste is added to the drum/container for the first time, not when the drum is full.

5.4.2. If a label is not available, use a paint marker and paint the following information on the side of the container: "Investigation derived waste pending determination", Container ID, description of the waste and accumulation date.

5.4.3. If it is known or presumed that the IDW generated meets the definition of a hazardous waste, the IDW drum shall be labeled as specified by the project manager and/or the site-specific Work Plan, but at a minimum should be marked with the words "hazardous waste" along with the other labeling information listed above.

5.5. Container Management

5.5.1. Only use containers that are compatible with the IDW generated.

5.5.2. Containers must be closed securely except when actively adding or removing waste.

5.5.3. Do not handle containers in a manner that could cause them to leak.

5.5.4. If a container holding IDW is not in good condition, or it begins to leak, transfer the IDW to another container in good condition.

5.5.5. Open-top drums are for the management of solid-phase IDW only (i.e., soil, PPE, disposable sampling equipment, debris). Liquid- phase IDW must not be managed in open-top drums.

5.5.6. Do not completely fill liquid containers. Leave at least two to four inches of headspace in all liquid containers to allow for expansion (in the event of heat generation or freezing conditions). To minimize the

potential for container failure, work with the client to arrange for disposal of the IDW as soon as possible following generation.

5.5.7. Any IDW that is known to be characteristically hazardous for ignitability (D001) or reactivity (D003) must be stored at least 50 feet from the facility property line.

5.6. Temporary storage area management

5.6.1. Containers of IDW known to be hazardous should be physically segregated from non-hazardous IDW to minimize the volume of hazardous IDW that must be disposed of.

5.6.2. Place containers on surface that will allow monitoring for leakage. Liquid containers must be stored off the ground surface (e.g., be placed on a shipping pallet). If the IDW is known or presumed that the IDW generated meets the definition of a hazardous waste, the IDW must be placed on an impervious surface, such as a coated concrete floor or a containment pallet. Asphalt or uncoated concrete do not constitute an impervious surface.

5.6.3. Provide adequate access to each container for the purposes of inspection and emergency response. Containers must be arranged so that each container may be accessed.

5.6.4. If the IDW is incompatible with other wastes generated or materials stored in the area, (e.g., acids and bases), segregate the containers by waste type. Do not store incompatible wastes/materials together.

5.6.5. Arrange containers on pallet in a manner in which that identification information is visible (facing outward).

5.6.6. If temporary storage area is located outside, cover containers with plastic sheeting and secure sheeting to prevent rips, tears, and loss (for non-hazardous drums only).

5.6.7. If there are a large number of containers, segregate by waste type (e.g., soil/groundwater/decon fluid, hazardous/non-hazardous/PCBs). It is likely that different handling will be required for the contents.

5.6.8. When demobilizing from the site, confirm waste container storage area is free of waste materials and/or debris upon departure. Photograph the storage area to document the condition, if possible.

5.7. Post-Job Client Communications

5.7.1. When applicable, after completion of sampling activities, provide the client with a copy of the IDW inventory on-site.

5.7.2 When applicable, provide receipt of the analytical data, provide the client with a copy of the data to assist with characterization and disposal of the IDW containers on-site.

5.7.3. Additional assistance with characterization and/or management of IDW may be provided for certain clients as specified by the project manager and/or the project-specific Work Plan.

6. Documentation

Documentation of field activities will be completed in accordance with SOP 10038 *Documentation and Integrity of Field Sample Activities*. In addition, the following documentation is required:

- Summarize waste container inventory on "Waste Container Inventory Sheet" included as Attachment 1, and include with daily field record sheets when no additional waste will be generated.
- Enter waste information into the Sharepoint waste spreadsheet to accurately track waste generation.
- Provide facility representative (where applicable) with waste container inventory to allow them to make arrangements for disposal.

7. References

EPA. *Science and Ecosystem Support Division, Operating Procedure SESDPROC-202-R1, July 2, 2014. Management of Investigation Derived Waste.* USEPA, Science and Ecosystem Support Division. 2014.

EPA. *Management of Remediation Waste under RCRA.* Publication EPA/530-F-98-026, October 1998.

EPA. *Superfund Program Representative Sampling Guidance, Volume 4: Waste.* OSWER Directive 9360.4-14, Publication EPA/540/R-95/141. December 1995.

EPA. Guides *to Management of Investigation-Derived Wastes.* OSWER Directive 9345.3-03FS. April 1992.

END OF DOCUMENT

ATTACHMENT 1: Waste Container Inventory Sheet

Loureiro Engineering Associates, Inc.
Standard Operating Procedure
for
Decontamination of Field Sampling Equipment

SOP ID: 10065
Date Initiated: 09/04/18

Revised By: ***/s/ David Payne*** ***04/04/18***
David Payne, P.E. **Date**
Project Manager

Reviewed By: ***/s/ Jo Ann Robertson*** ***09/04/18***
Jo Ann Robertson **Date**
Technical Associate

Approved By: ***/s/ Karen Harris*** ***09/04/18***
Karen Harris **Date**
Quality Assurance Manager

□ev □	Date	□dditions/Deletions/Modi□ications
□nitial □ssue	0□/□□/□□	

Loureiro Engineering Associates, Inc.
Standard Operating Procedure
For
Decontamination of Field Sampling Equipment

1. Purpose and Scope

□his document outlines □rocedures □or decontaminating sam□ling and □rocessing e□ui□ment contaminated by either organic or inorganic materials□ □o □revent cross contamination o□ sam□les, all reusable sam□ling and □rocessing e□ui□ment □ill be decontaminated be□ore each use□ □he □rocedures outlined in this document are site□ s□eci□ic □ regards to sam□ling methods and constitutes o□concern□ □he □rocedures outlined in this document are in accordance □ith the Environmental □rotection □gency □E□□□ document entitled, SESD□□□□□□0□□□□ *Field Equipment Cleaning and Decontamination*□

2. Related Standard Operating Procedures

- □00□□ □Management o□□nvestigation Derived □ aste

□n addition to the above□noted S□□, □ro□ect and client s□eci□ic re□uirements may be a□□licable to individual □ro□ects and should be discussed □ith the □ro□ect Manager and incor□orated into the □ro□ect s□eci□ic □or□ □lan □□ or□ □lan□□or adherence during the e□ecution o□the □ro□ect□

3. Definitions

None□

4. Equipment

□he □ollo□ing e□ui□ment and su□□lies shall be used during e□ui□ment decontamination activities, as re□uired:

- □ealth and sa□ety e□ui□ment □as re□uired by the site s□eci□ic □ealth and Sa□ety □lan □□ □S□□□
- Scrub brushes □at least □□
- □olyethylene □lastic sheeting □□millimeter or thic□er□
- □lean □□gallon buc□ets
- □versi□ed □lastic tub □secondary containment□□or drilling tooling
- Distilled/Deioni□ed □ ater □D□□ater□

- □i□uino□or other □hos□hate□free detergent
- □0□ methanol
- □0□ nitric acid
- □00□ he□ane
- □00□ml laboratory s□uirt bottles
- □lastic bags □si□e based on e□ui□ment□
- □luminum □oil
- □arge heavy□duty garbage bags
- □00 ml □lastic s□uirt bottles
- □a□er to□els and/or clean cloths

5. Procedures

□□□□ Site □re□aration

□□□□□□ □evie□ and □ollo□ the health and sa□ety □rocedures or re□uirements s□eci□ied in the site s□eci□ic □□S□□□ll necessary □ersonal □rotective e□ui□ment □□□E□shall be donned as s□eci□ied in the site s□eci□ic □□S□□

□□□□□□ □ section o□□olyethylene □lastic sheeting shall be cut o□su□icient si□e to underlie the decontamination area to contain any discharge o□ decontamination solutions□

□□□□□□ □he □ollo□ing solutions □as a□□ro□riate □or the antici□ated contaminants□ shall be □re□ared and □laced in □00□ml laboratory s□uirt bottles: methanol solution □less than □0□ solution□□□0□ nitric acid solution□□00□ he□ane solution□and distilled deioni□ed □D□□□ater□□ i□th solution o□□hos□hate□ □ree detergent and ta□□ater □a□□ro□imately □□□gallons□shall be □re□ared in a clean □ive□gallon buc□et□

□□□□ Decontamination □rocedures

□ll loose debris shall be removed □rom sam□ling e□ui□ment into an em□ty □□ gallon buc□et or □lastic sheeting, using a sti□□bristled brush□

□he order o□decontamination solutions is as □ollo□s:

□□ Detergent Scrub

□□ D□□ ater □inse

□□ □e□ane □inse □to be used only i□se□arate□□hase □etroleum □roduct, other than gasoline, is □resent□

□□ D□□ ater □inse

□□ □0□ Nitric □cid □inse □to be used only □hen inorganics are sus□ected as □otential contaminants□

□□ D□□ ater □inse

□□ Methanol □inse □to be used only □hen organics are sus□ected as □otential contaminants□

□□ □ir Dry

□□ter decontamination o□all sam□ling e□ui□ment, dis□ose o□□□E, loose material and decontamination □luid in accordance □ith □or□ □lan and S□□ □00□□ *Management of Investigation Derived Waste*□

□□□□ S□eci□ic □onstitute □rocedures

□he s□eci□ic □rocedures □or decontamination o□non□dis□osable small sam□ling e□ui□ment used during soil, sediment, ground□ater and or sur□ace □ater collection □i□e□hand auger buc□et, s□atulas, s□oons, bo□ls, cutting shoe, etc□□that comes in contact □ith organic and/or inorganic contamination□

□□□□□ □leaning o□ Small Sam□ling E□ui□ment □hen □naly□ing □or □rganic □om□ounds

□□ □□necessary, remove all loose debris □rom sam□ling e□ui□ment into an em□ty clean □□gallon buc□et or □lastic sheeting, using a clean dedicated sti□□bristled brush□

□□ Scrub sam□ling e□ui□ment thoroughly using a second clean dedicated brush and non□□hos□hate detergent to removal all visible □articulate matter□

□□ □horoughly rinse e□ui□ment □ith D□□ater into a □□gallon buc□et □sam□ling e□ui□ment can be rinse o□□into non□□hos□hate detergent and □ater buc□et□ to remove non□□hos□hate detergent □rom sam□ling e□ui□ment□

□□ □□ se□arate□□hase □etroleum □roduct, other than gasoline, □as encountered, care□ully rinse e□ui□ment □ith □00□ he□ane □rom s□uirt bottle, and let e□cess solvent drain into a se□arate □aste □□ gallon buc□et□

□□ a he□ane rinse □as used, rinse sam□ling e□ui□ment □ith D□ □ater into same □aste □gallon buc□et□

□□ □are□ully rinse sam□ling e□ui□ment □ith a □0□ methanol □rom s□uirt bottle, and let e□cess solvent drain into a se□arate □aste □□ gallon buc□et□

□□ □inse sam□ling e□ui□ment □ith D□□ater in □aste □gallon buc□et and allo□ sam□ling e□ui□ment to air dry□ E□ui□ment does not need to be dried □rior to use□

□□ □□the sam□ling e□ui□ment is not to be used immediately, □ra□ in aluminum □oil or □lace in a clean □lastic bag until ready □or use□

□□ter decontamination o□all sam□ling e□ui□ment, dis□ose o□ □□E and decontamination □luid in accordance □ith □or□ □lan and S□□ □00□□ *Management of Investigation Derived Waste*□

□□□□□ □leaning o□ Small Sam□ling E□ui□ment □hen □naly□ing □norganic □om□ounds

□□ □□necessary, remove all loose debris □rom sam□ling e□ui□ment into an em□ty clean □gallon buc□et or □lastic sheeting, using a clean dedicated sti□□bristled brush□

□□ Scrub sam□ling e□ui□ment thoroughly using a second clean brush □ith non□□hos□hate detergent to removal all visible □articulate matter□

□□ □horoughly rinse e□ui□ment □ith D□□ater to remove non□□hos□hate detergent □rom sam□ling e□ui□ment into a □gallon buc□et sam□ling e□ui□ment can be rinse o□□into non□□hos□hate detergent and □ater buc□et□□

□□ □are□ully rinse sam□ling e□ui□ment □ith a □0□ nitric acid □rom s□uirt bottle, and let e□cess acid drain into a se□arate □aste □gallon buc□et□

□□ Double rinse □ith D□ □ater into same □gallon buc□et and allo□ sam□ling e□ui□ment to air dry□ E□ui□ment does not need to be dried □rior to use□

□□ □□the sam□ling e□ui□ment is not to be used immediately, □ra□ in aluminum □oil or □lace in clean □lastic bag until ready □or use□

□□ □□ter decontamination o□all sam□ling e□ui□ment, dis□ose o□□□E and decontamination □luid in accordance □ith □or□ □lan and S□□ □00□□ *Management of Investigation Derived Waste*□

□□□□ S□eci□ic □ield E□ui□ment □rocedures

□he □ollo□ing □rocedures are s□eci□ic decontamination □rocedures □or hand auguring, direct □ush drilling, sediment sam□ling, ground□ater sam□ling and sur□ace □ater sam□ling□

□□□□□□ Direct □ush Drilling E□ui□ment

□n □re□aration o□cleaning drilling tooling, a □ mil thic□ □lastic sheeting □ill be laid out and a clean over si□ed □lastic tub □secondary containment□ □ill be □laced on □lastic sheeting□ □□gallon rinse buc□ets should □lace □ithin the □lastic tub□ □□the drill rig or any heavy e□ui□ment comes in contact □ith contaminated soil, a decontamination □ad should be constructed □ith the s□eci□ication listed belo□□ Drilling e□ui□ment that comes in contact □ith sam□le media should be cleaned in the □ield □er the □rocedures described above□ □his includes but not limited to □iston sam□ler □oint, screen □oint sam□ler, cutting shoes, and drive rods□

Dis□osable material such as sam□le tube liners, and sam□le tubing is not to be reused and is to be □laced in a large heavy duty garbage bag □hich □ill be managed in accordance □ith Section □□□□

□□□□□□ □leaning o□Direct □ush Drilling E□ui□ment

□□ □emove all loose debris □rom sam□ling e□ui□ment into an em□ty □□ gallon buc□et or onto □lastic sheeting using a sti□□bristled brush, □a□er to□el and/or cloth rag□

□□ □rea□ do□n com□onents o□ the sam□ling tooling to clean each individual com□onent se□arately□

□□ Scrub sam□ling e□ui□ment thoroughly □ith non□□hos□hate detergent to removal all visible □articulate matter□

□□ □horoughly rinse e□ui□ment □ith D□□ater to remove non□□hos□hate detergent □rom sam□ling e□ui□ment into a □□gallon buc□et □sam□ling e□ui□ment can be rinse o□□ into non□□hos□hate detergent and □ater buc□et□□

□□ □ollo□ Ste□s □through □as described above □or organic and inorganic com□ounds as s□eci□ied□

□□□□□□ Decontamination □ad S□eci□ication

□ decontamination □ad □ill be constructed only □or the □ur□ose □or a drill rig and/or heavy e□ui□ment to drive into □ad to be □ashed bet□een mobili□ations □rom areas o□ elevated contamination to relatively lo□ contamination or o□site□ □he □ad should be constructed in an area believed to be □ree o□sur□ace contamination□ □he □ad should be bermed to eliminate □otential lea□ing□

□he □ad should be constructed on a level sur□ace and should □acilitate the removal o□□ash □ater□ □his may be accom□lished by either creating a sum□ or □it in one corner or along one side or constructing the □ad □ith one corner lo□er than the rest□

□ ooden □allets should be used □or heavy tooling such as hollo□ stem augers so that the liner is not com□romised □rom the □eight and edges o□ the tooling□

□ ash □ater should be removed □orm decontamination □ad □re□uently and stored in a□□ro□riate labeled containers and stored □ith other investigation derived □aste containers□

□□ter com□letion o□ investigation, the decontamination □ad should be deactivated□□ll □aste □ater □ill be □um□ed into a□□ro□riatly labeled containers and the area □here the □ad □as staged should be return to its original state□

□□□□□ Sediment Sam□ling

□ny non□dis□osable □ibracore sediment e□ui□ment □core catcher□that is used to obtain or comes in contact □ith sam□le media is to be cleaned in the □ield in accordance □ith the □rocedures described in Section □□□

□□□ □ aste Management

□nvestigation derived □astes □□D□ □, including decontamination li□uids and dis□osable materials □□E, □lastic sheeting, etc□, □ill be □laced in clearly labeled, containers □a□□ro□riate to material □roduced□in accordance □ith S□□ □00□□ *Management of Investigation Derived Waste*, or managed as other□ise s□eci□ied in the site s□eci□ic □ or□□lan□

6. Documentation

Documentation o□ the decontaminations □ill be com□leted in accordance □ith S□□ □00□□ *Documentation of Field Sample Activities*□ □he com□leted decontamination □rocess □ill be recorded in the □ield notes□

7. References

E□□ □*SESDPROC – Field Equipment Cleaning and Decontamination*□□□/□□/□0□□□

END □□D□□□MEN□

Loureiro Engineering Associates, Inc.
Standard Operating Procedure
for
Handling, Packaging, and Shipping
of
Analytical Samples

SOP ID: 10067
Date Initiated: 07/23/18

Prepared By: ***/s/ Jo Ann Robertson*** ***07/19/18***
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Reviewed By: ***/s/ William Morris*** ***07/19/18***
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Karen Harris **Date**
Quality Assurance Manager

□ev □	Date	□dditions/Deletions/Modi□ications
□nitial □ssue	0□/□□/□□	

Loureiro Engineering Associates, Inc.
Standard Operating Procedure
for
Handling, Packaging, and Shipping of Analytical Samples

1. Purpose and Scope

This document describes the procedures to be followed for the protocols pertaining to the handling of samples in the field, chain of custody documentation, and the packaging and shipping of analytical samples. This Standard Operating Procedure (SOP) is to be used in conjunction with other Loureiro Engineering Associates, Inc. (LEA) SOPs and guidance for the performance of the associated field sampling activities.

The shipment (including packing, marking and labeling) of analytical samples is regulated by Department of Transportation under 49 CFR, Subchapter C, Hazardous Materials Regulations, and the International Air Transport Authority (IATA), which is equivalent to United Nations International Civil Aviation Organization (UN/ICAO). Anyone handling, packing, submitting a cooler or sample package for shipment must have IATA training every three years. Training records must be kept in the Central File.

This SOP does not cover the transport of Materials of Trade in LEA vehicle or shipment of large sample containers.

2. Related Procedures

Project and client specific requirements may be applicable to individual projects and should be discussed with the Project Manager and incorporated into the Project specific Work Plan or field sampling plan.

3. Definitions

- Dangerous Goods: those goods that meet the criteria of one or more of the nine UN hazard classes.
- Inner Packing: a package for which an outer package is required for transport (for example, a sample bottle).
- Outer Packaging: the outer protection of a composite or combination packaging together with any absorbent materials, cushioning and any other components necessary to contain and protect sample bottles.
- Carrier: A commercial company that is responsible for the actual shipment of environmental samples from the point of sample receipt from the shipper to the sample's final destination.

- □ustody □as de□ined in Section □□□□□□□ o□E□□, □□□□□: □ sam□le is under custody i□ one or more o□the □ollo□ing criteria are met:
  - □he sam□le is in the sam□ler□s □ossession
  - □t is in the sam□ler□s vie□ a□ter being in □ossession
  - □t □as in the sam□ler□s □ossession and then □as loc□ed u□to □revent tam□ering
  - □t is in a designated secure area

4. Equipment

□he □ollo□ing e□ui□ment and su□□lies shall be used during the handling, □ac□aging, and shi□□ing o□analytical sam□les, as re□uired:

- □ooler
- Sam□le labels
- □arge □lastic bag
- □a□e
- □ens □ball□oint□
- Shi□□ing labels
- □ield □a□er□or□
- □ac□aging ta□e
- □rotective □ac□aging materials □i□e□, □oam, bubble □ra□□
- □ustody seals
- □hain o□□custody □orms
- □i□loc bag or e□uivalent

5. Procedures

□□□ □re□□ield □rocedures

□btaining Sam□le □abels:

□□□□□ □rior to initial start□u□ activities, the □ro□ect Manager, or □ro□ect Designee, shall submit the □ro□er site in□ormation to the Database Manager□ □his in□ormation shall include: □ro□ect name, client name, commission and tas□ number, site name, site location, □ield □ersonnel, □ro□ect start date, ty□e o□ □ield □or□, number and matri□ o□ sam□les antici□ated, analyses to be □er□ormed, any re□uired □ield □orms, and a□□ro□imate duration o□□ield activities□

□□□□□ □nce the site in□ormation is entered in the database, re□uested □ield □a□er□or□, sam□le identi□ication numbers, sam□le labels, and custody seals may be obtained directly by □ield □ersonnel through the database or by re□uesting □re□aration by the Database Manager□ □his tas□ should be com□leted □□ to □□ hours □rior to initiation o□□ield activities□

□□□□□ Sam□le □abels □ Sam□le labels □ill have multi□le uni□ue seven□digit identi□ication numbers, generated by the □oureiro database, □rinted on adhesive labels □ith analysis classes □rinted on them□ □he labels □ill be used to adhere to the a□□ro□riate containers □□ttachment □□□

□□□ Shi□□ing Determination

□rior to the mobili□ation □or any sam□ling activities, the □ollo□ing ste□s must be com□leted to determine the ha□ard classes o□ the material to be shi□□ed or trans□orted□ Environmental sam□le are not e□cluded □rom □□□□ or D□□ regulation□

□□□□□ □he □ro□ect team shall identi□y the □otential constitutes and the a□□ro□imate concentrations in the sam□le using historical data or □ro□essional □udgment based on the historical use o□ the area□ □lso, determine □hat sam□le □reservatives □ill be used and volume in each bottle and the number o□ sam□les that □ill be in each cooler□

□□□□□ □he □ro□er shi□□ing name □ill be determined using the □□□□ □ist o□ Dangerous □oods in Section □ o□ the □□□□ Dangerous □oods Manual□ □nce the □ro□er shi□□ing name has been determined, use □ist o□ Dangerous □oods to determine the □ollo□ing:

- □e□uirements □or both inner and outer □ac□aging
- □he □uantity o□ the material that can be shi□□ed as a non□dangerous good□□uality limits □ill include both the sam□le si□e and the number o□ sam□les □er cooler or □ac□age
- □dditional shi□□ing instructions

□he results o□ the Dangerous □oods analysis, including the □ro□er shi□□ing name, □ac□aging re□uirements and any s□ecial instructions □ill be documented and stored in the □ro□ect □ile ***even it not determined to be a dangerous good.***

□he shi□□ing determinations are used as a method o□ ha□ard communication □hile the sam□les are in transit□□he shi□□ing determination □ill hel□ the carrier or authorities determine the best a□□roach □or addressing a release□

□he shi□□ing determination □ill be com□leted even i□ the sam□les are being trans□orted by a carrier because □E□ cannot control the trans□ortation method once it releases custody o□ the sam□les to the carrier□

□□ the sam□les are not determined to be a Dangerous □ood and do not re□uire s□eci□ic □ac□aging, they can be trans□orted in a cooler□

□□□ □hain□o□□□ustody □orm □rocedures

□nce the sam□les have been collected, custody o□the sam□les must be trac□ed□ E□am□le chain o□□custody □orms and custody seals are □rovided in □□endi□□□ □he □ollo□ing in□ormation shall be □rovided on the chain o□□custody □orms:

- □rior to collecting sam□les, □ill out the □ro□ect in□ormation i□e□, □ro□ect name, number, sam□ler names□in the headers on the chain o□□custody □orm using a ball□oint □en□
- □s sam□les are collected, s□eci□y the □E□ seven□digit sam□le number, date and time o□collection, sam□le matri□, the ty□e o□analytical □arameters and methods re□uested, and the □reservatives used on the chain o□□custody□
- □or a□ueous sam□les, the in□ormation □rovided should clearly indicate □hich □reservative is used □or □hich analyses□
- □se the su□i□ □u□□ a□ter the seven□digit □E□ sam□le number to denote un□iltered metal sam□les, as a□□licable□
- S□eci□y □hether an electronic data deliverable □EDD□ or data validation □ac□age is re□uired□
- S□eci□y the laboratory □uote number, or any additional □ro□ect s□eci□ic re□uirements, such as re□orting limits□

□□□ □andling and □ustody o□Sam□les

□□□□□ Each sam□ling team □ill maintain a cooler containing ice and a□□licable □□/□□ □tri□ blan□□sam□les □rior to and during sam□le collection□□he bottom o□the cooler □ill be lined □ith □ac□aging material, and ice inside o□the cooler □ill be double bagged in sealed □i□loc bags to □revent sam□les □rom directly contacting melted ice and to □revent lea□age during shi□ment and/or trans□ortation□□□lue □ce□shall not be used□

□□□□□ □oolers containing sam□les □ill be labeled □ith a uni□ue, seven□digit, □E□ number, □hich □ill be recorded in the □ield □a□er□or□□

□□□□□ □ollection o□sam□les □ill adhere to a□□licable □E□ sam□le collection S□□s, as identi□ied in the site s□eci□ic □or□□lan or □ield sam□ling □lan□

□□□□□ □ollo□ing collection into labeled, laboratory □rovided sam□le □are, sam□les □ill be □laced in □rotective □ac□aging □oam, bubble □ra□, or other □rotective □ac□aging material□, and then directly into the cooler containing ice and □□/□□ sam□les□

□□□□□ □E□ □ersonnel □ill maintain custody o□the sam□les according to the de□inition o□custody as outlined in Section □until custody is trans□erred to

the laboratory courier, or acce□ted □or shi□ment by a third □arty carrier (Shi□□ing o□sam□les is covered in Section 5.5).

5.4.6 □he chain o□ □custody shall be □laced inside o□a □i□loc or e□uivalent bag and ta□ed to the lid o□each cooler.

5.5 Shi□□ing □rocedure

□rior to the mobili□ation □or any sam□ling activities, the □ollo□ing ste□s must be ta□en to determine the ha□ard classes o□the material to be shi□□ed (covered in Section 5.2)

If sam□les are shi□□ed on □riday or be□ore a holiday, contact the laboratory to determine □hen the laboratory is acce□ting sam□les. If shi□□ing on □riday, mar□ "Saturday Delivery" on the □edE□ shi□□ing label. UP S does not deliver on Saturdays.

How to □ac□a cooler □or trans□ort:

5.5.1 Select a cooler that is in good re□air and clean. Secure and ta□e the drain □lug □ith ta□e inside and out.

5.5.2 Double bag ice in heavy duty □i□loc□ (or e□uivalent) bag. Do not over□ill the bag □ith ice and con□irm double bag are securely closed. "□lue □ce" shall not be used because o□ the □ossibility o□ sam□les begin cross-contaminated.

5.5.3 Each sam□le shall be bagged in se□arate bags. Multi□le sam□le □ars or bottles com□rising a sam□le can be bagged together □roviding the bottles and □ars are □ra□□ed to □revent brea□age. □lass 4)□milliliter (m□) vials containing sam□les □or analysis o□ VOC s □ill not be bagged □ith any other bottles or □ars. □lass 4)□m□ vials shall not be □ac□ed in the sam□le bag □ith sam□les □rom another location. If vials are trans□orted in a □oam a□□aratus, sam□les □rom di□□erent locations can be bagged together □rovided the level o□contamination is generally the same (do not □lace □no□n or sus□ected lo□ concentration sam□les and □no□n or sus□ected high concentration sam□les together). □he sam□les □ill be bagged in resealable □lastic bags or sealed in bubble □ra□envelo□es.

5.5.4 □ut a layer o□bubble □ra□on the bottom and along the sides o□the cooler.

5.5.5 □lace the sam□les and ice into a large clear □lastic bag. □he ice bags should be □laced along all sides o□cooler and on the to□ o□the sam□les. □lass 4)□m□ vials □ill be □laced in the center o□the cooler. □he □lastic bag □ill be sealed □ith ta□e once the sam□les and ice are □laced in the coolers.

□are □ill be ta□en □hen □ac□ing coolers □or shi□ment during e□treme tem□eratures □hot or cold). E□tra ice □ill be used during □eriods o□ elevated tem□erature. □ hen the tem□erature is belo□ □ree□ing, □ee□ the glass □ars or bottles in the center o□the cooler and e□tra bubble □ra□ □ill be used to insulate the sam□le so the glass bottles are not shattered by e□□ending □ater. □lass 4)□m□ vials □ill be □laced on their sides so that e□□anding □ater □ushes against the ca□ o□the sam□le.

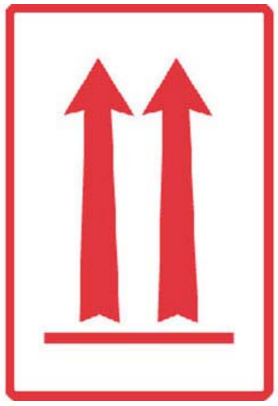
5.5.6 □he chain o□ custody □orm shall be □laced inside o□ a □i□loc bag or e□uivalent and ta□ed to the inside lid o□ each cooler. If the chain o□-custody □orm includes sam□les in multi□le coolers, a co□y o□the chain o□-custody □orm □ill be □laced in each cooler and a note □ill be added that the cooler is one o□a grou□ o□ coolers.

5.5.7 Tw o custody seals should be used, one □laced over the □ront o□ening and the other over the side o□ening (□or hinged cooler lids) or the bac□ o□ening (□or non□hinged cooler lids). □lear □ac□ing ta□e should be □laced over the signed and dated custody seal. □he ta□e should be □laced so that it covers one hal□ o□the custody seal, continues around the cooler, and then covers the entire custody seal. □he custody seal number□s) should be recorded on the chain o□ custody □orm.

5.5.8 Seal the cooler using sturdy ta□e.

5.5.9 □lace u□arro□, the "□ac□age contains □et ice", and □ragile stic□ers on the outside o□the cooler. E□am□les are □rovided belo□. □lace any additional stic□ers onto the cooler as re□uired by IATA.

5.5.1) If the shi□ment trac□ing number is □no□n be□ore the coolers are sealed, the trac□ing number should be recorded on the chain o□ custody □orm be□ore it is sealed in the cooler □so that it is on all co□ies o□the COC) and in the □ield notes. If the trac□ing number is not □no□n until shi□ment, it should be recorded on the retained co□y o□the chain o□ custody and in the □ield notes.



6. References

S M. *ASTM D4840 - Standard Guide for Sampling Chain-of-Custody Procedures.* 2)11).

S M. *ASTM D6911-15 Standard for Packing and Shipping Environmental Laboratory Analysis*. 2)18.

EPA. *A Compendium of Superfund Field Operations Methods: Volume 1.* S EPA OSWER Directive 9355 0-14. 1987.

IATA. *IATA Dangerous Goods Regulations (DGR) Manual*, nternational ir rans ort uthority. 2)17.

END OF D MEN

Loureiro
Engineering • Construction • EH&S • Energy
Waste • Facility Services • Laboratory

ATTACHMENT 1

E□am□le □hain□o□□□ustody

CHAIN-OF-CUSTODY

Tunxis Laboratories, LLC
100 Northwest Drive
Plainville, Connecticut 06062
Tel: (860) 793-8866

Chain of Custody # **8183**

Client: | Project Location: | Analysis Required: | Project Number / P.O. Number

REPORT TO:
INVOICE TO:

Turnaround: 14 days Rush ____

Item	Sample Number	Source Code	Date of Collection	Time of Collection	Container Information				Tunxis Lab. No.	Transfer Number			
					Number	Type	Volume	Pres.		1	2	3	4
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													
13													

Sampler:

Source Codes: W=Well MW=Monitoring Well RO=Runoff B=Bottom Sediment T=Treatment Facility
S=Soil SG=Sludge LF=Landfill L=Lake/Ocean O=Outfall X=Other, Please Specify

Preservation Code: I=Iced S=H2SO4 N=HNO3
H=HCL R=NaOH T=Sodium Thiosulfate F=Filtered

Transfer Number	Transfers Relinquished By	Accepted By	Date	Time
1				
2				
3				
4				

Comments:

ATTACHMENT 2

E□am□le Sam□le □abels

Sample ID 1378555
07MD509.001
Centredale Manor Litigation Support
VOC Scan
Date:___/___/___ Time:___:___

Sample ID 1378555
07MD509.001
Centredale Manor Litigation Support
VOC Scan
Date:___/___/___ Time:___:___

Sample ID 1378555
07MD509.001
Centredale Manor Litigation Support
VOC Scan
Date:___/___/___ Time:___:___

Sample ID 1378555
07MD509.001
Centredale Manor Litigation Support
SVOC Scan
Date:___/___/___ Time:___:___

Sample ID 1378555
07MD509.001
Centredale Manor Litigation Support
PCB Scan
Date:___/___/___ Time:___:___

Sample ID 1378555
07MD509.001
Centredale Manor Litigation Support
Metals
Date:___/___/___ Time:___:___

Sample ID 1378555uf
07MD509.001
Centredale Manor Litigation Support
Metals (unfiltered)
Date:___/___/___ Time:___:___

Sample ID 1378555
07MD509.001
Centredale Manor Litigation Support
TPH
Date:___/___/___ Time:___:___

Sample ID 1378555
07MD509.001
Centredale Manor Litigation Support
ETPH
Date:___/___/___ Time:___:___

Sample ID 1378555
07MD509.001
Centredale Manor Litigation Support
Standard Leachate
Date:___/___/___ Time:___:___

Sample ID 1378555
07MD509.001
Centredale Manor Litigation Support
Pesticides/Herbicides
Date:___/___/___ Time:___:___

Sample ID 1378555
07MD509.001
Centredale Manor Litigation Support
Physical Analyses
Date:___/___/___ Time:___:___

Sample ID 1378555
07MD509.001
Centredale Manor Litigation Support
Miscellaneous Analyses
Date:___/___/___ Time:___:___

Sample ID
.
Date:___/___/___ Time:___:___

Sample ID
.
Date:___/___/___ Time:___:___

Sample ID 1378556
07MD509.001
Centredale Manor Litigation Support
VOC Scan
Date:___/___/___ Time:___:___

Sample ID 1378556
07MD509.001
Centredale Manor Litigation Support
VOC Scan
Date:___/___/___ Time:___:___

Sample ID 1378556
07MD509.001
Centredale Manor Litigation Support
VOC Scan
Date:___/___/___ Time:___:___

Sample ID 1378556
07MD509.001
Centredale Manor Litigation Support
SVOC Scan
Date:___/___/___ Time:___:___

Sample ID 1378556
07MD509.001
Centredale Manor Litigation Support
PCB Scan
Date:___/___/___ Time:___:___

Sample ID 1378556
07MD509.001
Centredale Manor Litigation Support
Metals
Date:___/___/___ Time:___:___

Sample ID 1378556uf
07MD509.001
Centredale Manor Litigation Support
Metals (unfiltered)
Date:___/___/___ Time:___:___

Sample ID 1378556
07MD509.001
Centredale Manor Litigation Support
TPH
Date:___/___/___ Time:___:___

Sample ID 1378556
07MD509.001
Centredale Manor Litigation Support
ETPH
Date:___/___/___ Time:___:___

Sample ID 1378556
07MD509.001
Centredale Manor Litigation Support
Standard Leachate
Date:___/___/___ Time:___:___

Sample ID 1378556
07MD509.001
Centredale Manor Litigation Support
Pesticides/Herbicides
Date:___/___/___ Time:___:___

Sample ID 1378556
07MD509.001
Centredale Manor Litigation Support
Physical Analyses
Date:___/___/___ Time:___:___

Sample ID 1378556
07MD509.001
Centredale Manor Litigation Support
Miscellaneous Analyses
Date:___/___/___ Time:___:___

Sample ID 1378557
07MD509.001
Centredale Manor Litigation Support
VOC Scan
Date:___/___/___ Time:___:___

Sample ID 1378557
07MD509.001
Centredale Manor Litigation Support
VOC Scan
Date:___/___/___ Time:___:___

Sample ID 1378557
07MD509.001
Centredale Manor Litigation Support
VOC Scan
Date:___/___/___ Time:___:___

Sample ID 1378557
07MD509.001
Centredale Manor Litigation Support
SVOC Scan
Date:___/___/___ Time:___:___

Sample ID 1378557
07MD509.001
Centredale Manor Litigation Support
PCB Scan
Date:___/___/___ Time:___:___

Sample ID 1378557
07MD509.001
Centredale Manor Litigation Support
Metals
Date:___/___/___ Time:___:___

Sample ID 1378557uf
07MD509.001
Centredale Manor Litigation Support
Metals (unfiltered)
Date:___/___/___ Time:___:___

Sample ID 1378557
07MD509.001
Centredale Manor Litigation Support
TPH
Date:___/___/___ Time:___:___

Sample ID 1378557
07MD509.001
Centredale Manor Litigation Support
ETPH
Date:___/___/___ Time:___:___

Sample ID 1378557
07MD509.001
Centredale Manor Litigation Support
Standard Leachate
Date:___/___/___ Time:___:___

Sample ID 1378557
07MD509.001
Centredale Manor Litigation Support
Pesticides/Herbicides
Date:___/___/___ Time:___:___

Sample ID 1378557
07MD509.001
Centredale Manor Litigation Support
Physical Analyses
Date:___/___/___ Time:___:___

Sample ID 1378557
07MD509.001
Centredale Manor Litigation Support
Miscellaneous Analyses
Date:___/___/___ Time:___:___

Sample ID 1378558
07MD509.001
Centredale Manor Litigation Support
VOC Scan
Date:___/___/___ Time:___:___

Sample ID 1378558
07MD509.001
Centredale Manor Litigation Support
VOC Scan
Date:___/___/___ Time:___:___

Sample ID 1378558
07MD509.001
Centredale Manor Litigation Support
VOC Scan
Date:___/___/___ Time:___:___

Sample ID 1378558
07MD509.001
Centredale Manor Litigation Support
SVOC Scan
Date:___/___/___ Time:___:___

Sample ID 1378558
07MD509.001
Centredale Manor Litigation Support
PCB Scan
Date:___/___/___ Time:___:___

Sample ID 1378558
07MD509.001
Centredale Manor Litigation Support
Metals
Date:___/___/___ Time:___:___

Sample ID 1378558uf
07MD509.001
Centredale Manor Litigation Support
Metals (unfiltered)
Date:___/___/___ Time:___:___

Sample ID 1378558
07MD509.001
Centredale Manor Litigation Support
TPH
Date:___/___/___ Time:___:___

Sample ID 1378558
07MD509.001
Centredale Manor Litigation Support
ETPH
Date:___/___/___ Time:___:___

Sample ID 1378558
07MD509.001
Centredale Manor Litigation Support
Standard Leachate
Date:___/___/___ Time:___:___

Sample ID 1378558
07MD509.001
Centredale Manor Litigation Support
Pesticides/Herbicides
Date:___/___/___ Time:___:___

Sample ID 1378558
07MD509.001
Centredale Manor Litigation Support
Physical Analyses
Date:___/___/___ Time:___:___

Sample ID 1378558
07MD509.001
Centredale Manor Litigation Support
Miscellaneous Analyses
Date:___/___/___ Time:___:___

ATTACHMENT 3

E□am□le □ustody Seal

CUSTODY SEAL

[LEA CUSTODY SEAL/COOLER ID NUMBER]

Date:	Sampler:
Time:	Signature

CUSTODY SEAL

[LEA CUSTODY SEAL/COOLER ID NUMBER]

Date:	Sampler:
Time:	Signature

CUSTODY SEAL

[LEA CUSTODY SEAL/COOLER ID NUMBER]

Date:	Sampler:
Time:	Signature

CUSTODY SEAL

[LEA CUSTODY SEAL/COOLER ID NUMBER]

Date:	Sampler:
Time:	Signature

CUSTODY SEAL

[LEA CUSTODY SEAL/COOLER ID NUMBER]

Date:	Sampler:
Time:	Signature

CUSTODY SEAL

[LEA CUSTODY SEAL/COOLER ID NUMBER]

Date:	Sampler:
Time:	Signature

CUSTODY SEAL

[LEA CUSTODY SEAL/COOLER ID NUMBER]

Date:	Sampler:
Time:	Signature

CUSTODY SEAL

[LEA CUSTODY SEAL/COOLER ID NUMBER]

Date:	Sampler:
Time:	Signature

CUSTODY SEAL

[LEA CUSTODY SEAL/COOLER ID NUMBER]

Date:	Sampler:
Time:	Signature

CUSTODY SEAL

[LEA CUSTODY SEAL/COOLER ID NUMBER]

Date:	Sampler:
Time:	Signature